Montana Outdoors

May/June 1980
One Dollar

Montana Outdoors
May/June 1980, Vol. 11, No. 4
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THE COVER: John Muir once wrote: "As long as I live, I'll hear waterfalls and birds and winds sing. I'll interpret the rocks, learn the language of flood, storm, and avalanche." Certainly part of the delicate language is that of wildflowers, as the front cover photograph of Indian pipe by the late Danny On aptly illustrates. For a "Guidepost to Summer" through the jewel-like array of Montana's wildflowers, turn to page 16. Cascading water, colorful lichens and a backdrop of pine trees are only part of the scenic advantages at Natural Bridge State Monument. During low water, water from Boulder River Falls disappears into an underground channel upstream; a natural rock bridge across the river channel is revealed (back cover photo: Paul Dix, Reflejo). To learn more about "Nature's Bridge," turn to Steve Joppa's article on page 14.

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The Editor's Column

Procrastination may be a universal affliction, but writers and editors seem to suffer from it more than most people. There are, I suppose, a few cheerful and efficient souls who turn out polished copy day after day, never missing a deadline. But they are few and far between, and I've never actually met one of them. The rest of us healthier, more normal people—the procrastinators—work in fits and starts, and have nightmares about blank pieces of paper staring back at us from patiently waiting typewriters.

Unfortunately, my procrastination isn't limited to composing prose for *Montana Outdoors*. That's why you're likely to find me wandering through shopping centers the day before Christmas, poring over income tax forms the night of April 14th and reloading shotgun shells the morning of a trapshooting meet. That's also why I don't get around to making my New Year's resolutions until about St. Patrick's Day, which this year just happened to coincide with the copy deadline for this issue.

So, for the sake of convenience, I celebrated St. Patrick's Day, made my New Year's resolutions and wrote the May/June editor's column all at the same time. Bear in mind, these are spring and summer resolutions only—any procrastinator worth his or her salt will defer fall resolutions until at least the Fourth of July.

* * * * *

I hereby resolve to bag one turkey gobbler, of the subspecies Merriam's, during the spring turkey season in eastern Montana. I further resolve to read the instructions that came with my turkey call prior to entering the woods on opening day. I now acknowledge the fact that wild turkeys exist in Montana, something I didn't believe for several years, having neither seen nor heard one in the course of many outings. But last year, while I was sitting in my car eating lunch, one gobbled a lusty rejoinder to the music on my car radio, providing undeniable proof of its presence in the state. I have yet to have one answer my turkey call but, like I said, this year I'm going to read the instructions in advance.

* * * * *

I hereby resolve to photograph a sharp-tailed grouse on its dancing grounds, in such a manner as to render it recognizable to an impartial panel of my peers. Last year I did obtain one photograph, taken from the canvas confines of a camouflage blind called the "Portable Fensman," an elaborate device that I ordered all the way from England. My picture, taken shortly before dawn, turned out a trifle dark; nonetheless, it shows something that could be a grouse—then again, it could be a rock. I didn't get a chance to take any more pictures, because as soon as it got light enough to see, the grouse took one look at the Portable Fensman and departed, presumably chuckling.

When I related my sad tale to a rancher acquaintance he offered this sure-fire advice: "Shucks, son, what you need is a pickup truck, not one of them camouflage contraptions. These birds are used to seeing pickup trucks—you can drive right up to the dancing grounds and shoot your pictures out of the window."

If you know anyone in the market for a portable blind imported from England, let me know.

* * * * *

I hereby resolve not to canoe the _____ stretch of the _____ River on Memorial Day weekend (like I tried to do last year), nor any other even remotely similar to it. I also resolve never to take 300 pounds of food and equipment (including a watermelon) on a canoe trip again, because it's hard to carry all the stuff out of a deep canyon and overland a mile to the nearest road. I further resolve not to tell anybody else which stretch of which river it was, because they invariably go "Ha, ha, ha! Why that little old river isn't deep enough to drown a bug, especially up *there*." Well, believe me, they weren't up *there* last Memorial Day.

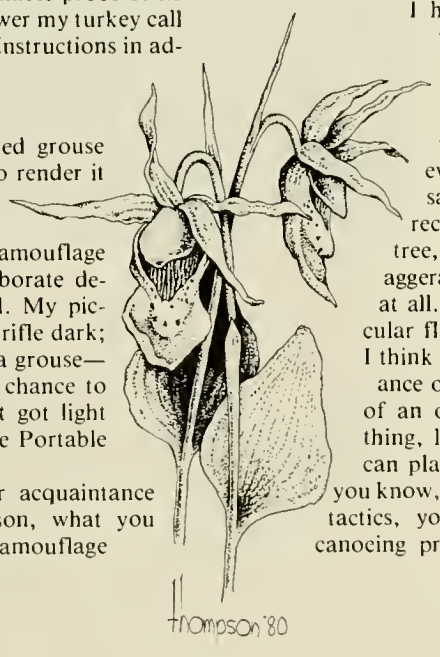
* * * * *

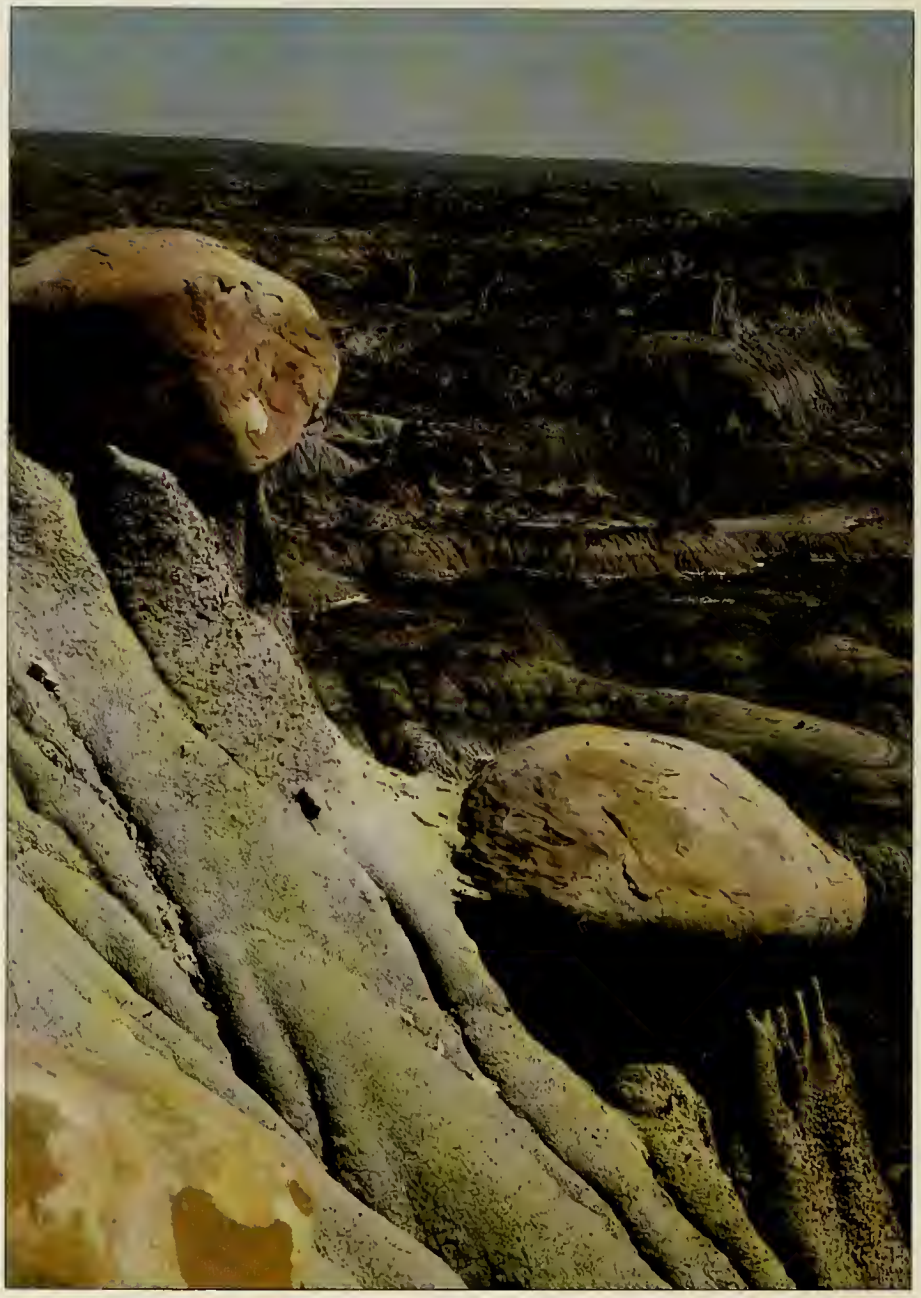
I hereby resolve not to take any more "shortcuts" on backpacking trips. So far they have led me and my unfortunate companions through jungles of downed timber, into impenetrable thickets of dog-hair lodgepole, up and down rocky cliffs and through slippery tangles of *Menziesia*, any of which can bring tears to the eyes of grown men. Last year's "shortcut," designed to hasten our departure from a rain-sodden Bob Marshall Wilderness, provided us the exquisite thrill of fording two streams in the dark, only to arrive at midnight, wet to our waists, at a car with a dead battery.

* * * * *

Finally, lest you begin to despair that this column has absolutely no bearing on anything in this issue of *Montana Outdoors*, I hereby resolve to learn the names of Montana's wildflowers, several of which are beautifully portrayed beginning on page 16. Actually, I can identify quite a few of Montana's flowers, but whenever I'm out with a group of people, someone will inevitably point to a flower I don't know and say, "What's that one?" The fact that I can recite the Latin name of every other flower, tree, bird and bug for miles around (a small exaggeration, perhaps) doesn't seem to impress them at all. They want to know the name of *that* particular flower—the one I don't know. I usually lie if I think I can get away with it, since admitting ignorance on such matters is embarrassing for the editor of an outdoor magazine. After all, a simple little thing, like not knowing the name of a wildflower, can plant a tiny seed of doubt. And the first thing you know, people are questioning your turkey hunting tactics, your outdoor photography techniques, your canoeing prowess, your map-reading skills. . . .

Dave Books





Coal Tax Trust Fund Acquisitions: NOMINATE YOUR FAVORITE PARK

by Terry Knupp

THINK ABOUT the outdoor recreation possibilities Montana offers. Then think about the places you visit frequently to enjoy your favorite outdoor pastime—perhaps a boat landing you have used for years, or a spot that provides you access to a fishing stream . . . or maybe a hillside where you have picnicked in the summer or practiced Nordic ski turns in the winter . . . or perhaps an area that contains evidence of Montana's colorful history. Would one of these areas be an appropriate component of our state park system?

If so, you now have the opportunity to propose that it be included. In early 1979, the Montana Legislature passed House Bill 550, which contains a section allowing "any person, association, or representative of a governing unit" to submit a proposal for acquisition of an area to be added to the state park system. House Bill 550 also states that these proposals must be submitted to the Department of Fish, Wildlife and Parks (DFWP), which in turn must present the proposals to the legislature by the 15th day of the legislative session. The legislature then selects the proposals to be funded.

The funding source for these new recreation areas is a portion of the revenue derived from Montana's coal severance tax (a tax on the mine-mouth value of coal). At present, 3⅓% of the distributed coal tax revenue is placed in a trust fund, from which only the interest can be drawn to acquire parks and recreation areas. This revenue may also be appropriated by the legislature for the management of areas acquired with coal tax revenue.

HOW TO SUBMIT PROPOSALS

To assist people in making proposals and to provide enough information for the legislature, the DFWP has developed a brochure and a short application form. The brochure explains the law and the criteria for additions to the park system. The application is simply a method of collecting a minimum of necessary information about the proposed area. A department representative will contact the submitter to obtain any additional information that may be needed. The brochure and application are available at regional depart-

When a key addition to Makoshika State Park (left) was offered for sale in 1978, funds from the coal tax trust fund permitted its acquisition (DFWP photo: Craig Sharpe). An addition to Giant Springs Heritage State Park (above), purchased in 1979, again with the help of the coal tax trust fund, helps to assure perpetuation of historical and recreational values that make this park a valuable asset to the state's park system (DFWP photo: Harley Yeager).

ment headquarters and at the Helena office. Inquiries can be addressed to: Parks Division, Department of Fish, Wildlife and Parks, 1420 E. Sixth Ave.; Helena, MT 59601. Applications will be accepted until Dec. 1, 1980.

WHAT KINDS OF AREAS QUALIFY?

As set forth by law, the purpose of the state park system is "to conserve the scenic, historic, archaeologic, scientific and recreational resources of the state, providing for their use and enjoyment and thereby contributing to the cultural, recreational, and economic life of the people and their health." To meet this charge, the Department of Fish, Wildlife and Parks was given the statutory authority to "acquire for the state any areas, sites, or objects which in its opinion would be held, improved, and maintained as state parks, state recreation areas, state monuments, or state historic sites." It is these park system components that are eligible to receive coal tax funding.

In the late 1960s, a classification scheme describing the purposes and physical characteristics of several types of state park system areas was developed and adopted as part of the Administrative Rules of Montana. The department classified state parks, state monuments, state recreation areas, state recreational waterways and others according to several criteria (see accompanying sidebar). These criteria provide standards for acquiring and designating park system components, as well as for determining appropriate development and management procedures.

PAST COAL TAX ACQUISITIONS

Since 1975, the portion of the coal severance tax earmarked for parks has provided seven additions to the state park system. Located throughout the state (see map), these sites offer a variety of recreational opportunities to Montanans and out-of-state visitors.

Roche Jaune State Recreation Area—Roche Jaune, a 1.5-acre area with a boat ramp fronting the Yellowstone River, became the first state recreation area purchased with money from the coal tax fund. The name Roche Jaune (a French word pronounced *row-shown*, meaning yellow rock)

was used as early as 1795 to describe the Yellowstone River.

Situated in Miles City, the recreation area serves an estimated 32,500 people who live within a day's travel of the site. It provides opportunities to float, swim, water ski, fish and hunt for agates. With over 200 feet of river frontage, the site was chosen because of a critical need for public river access on the Yellowstone. Roche Jaune now provides the only public recreation access to the Yellowstone River in the 100-mile stretch from the Rosebud State Recreation Area at Forsyth to the Fallon Bridge Fishing Access upstream.

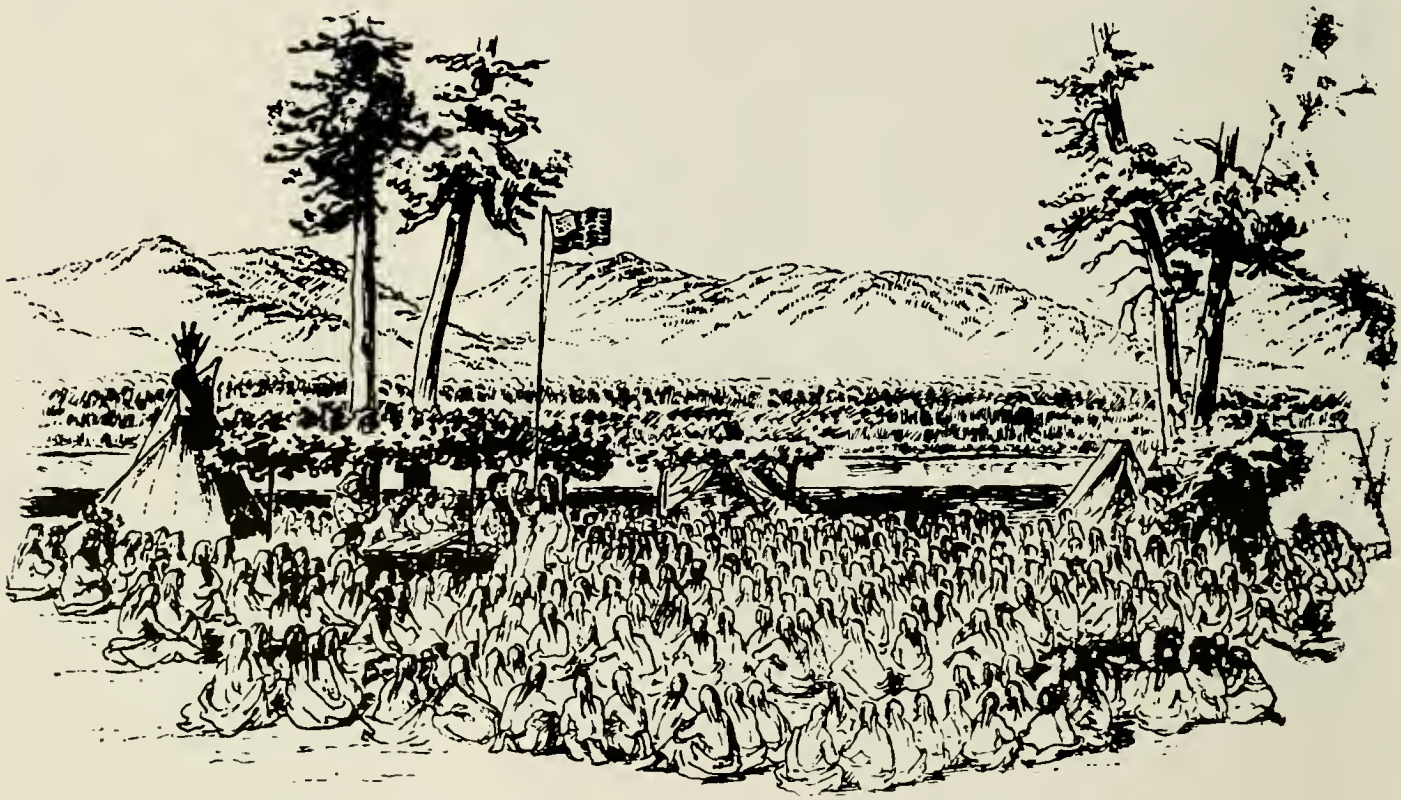
Makoshika State Park Addition—The second acquisition with coal tax funds was a 650-acre addition to Makoshika State Park. Although the state park was established in 1953, only 160 acres of Makoshika's 56,000 acres of badland scenery were originally under public protection. As a result, people often trespassed onto private land when visiting the park. In recent years, easements with various owners have brought nearly 4,000 acres of Makoshika under park management. When an additional key section at the entrance of the park road was offered for sale in 1978, funds from the coal tax permitted its acquisition.

Bannack State Park Addition—Although smallest of the coal tax acquisitions, the Bannack State Park addition is a significant investment in the protection of Montana's first territorial capital. For the past 10 years, the DFWP has worked to restore some of the ghost town's original buildings and grounds. The coal tax fund allowed acquisition of a lot fronting the east end of Bannack's main street, thus preserving another valuable piece of Montana's historical heritage.

Council Grove State Monument—Council Grove fits one of the park system criteria very well: that of preserving and protecting places of historical significance, including those that commemorate outstanding events. Council Grove State Monument marks the site of an 1855 council between Isaac Stevens and the Flathead, Kootenai and Pend d'Oreille Indians. Here they signed the Hellgate Treaty, an agreement by which the Indians relinquished their ancestral hunting grounds in exchange for a reservation in the Mission Valley. This marked the end of Indian dominance in western Montana, opening the land for settlement.

Aside from its historical significance, the site's location on the Clark Fork River, its huge ponderosa pines, shady cottonwoods, marshland and prairie combine to make the 186-acre parcel a welcome addition to Montana's recreational estate.

Rosebud Battlefield State Monument—From the time that coal tax revenue became available for park acquisitions, the Rosebud Battlefield was a top priority for inclusion in the state park system. This 881,000-acre area was the site of the significant battle between General George Crook's command and an estimated 1,500 Sioux and Cheyenne warriors in 1867. This property is significant not only because of its history as a battle-



Council Grove State Monument marks the spot where Isaac Stevens held a council to induce the Flathead, Kootenai and Pend d'Oreille Indians to sign the Hellgate Treaty relinquishing their ancestral hunting grounds to the white man in exchange for a reservation in the Mission Valley (graphics: Smithsonian Miscellaneous Collections).

field, but because it contains a prehistoric buffalo jump and displays evidence of early cattle ranching as well. It is the largest coal tax acquisition to date.

Giant Springs Heritage State Park Addition—After Giant Springs became a state park in 1972, the recreational and interpretive facilities were improved. Then, in 1979, the DFWP negotiated for an addition to the park with the support of the Heritage Park Commission (a group of interested Great Falls residents). Following these negotiations, the department purchased, with money from the coal tax fund and federal matching funds, a tract proposed for subdivision development adjacent to the park. This new parcel will help assure the perpetuation of the historical and recreational values that have made Giant Springs Heritage State Park such a valuable component of Montana's state park system.

Lake Josephine—One of the state park system's purposes is "to conserve the state's recreational resources and to provide for their use and enjoyment." In 1979, using coal tax funds matched with federal grant money, the department purchased a tract on the outskirts of Billings commonly referred to as Lake Josephine. The Lake Josephine property has several open ponds that offer fishing and swimming opportunities for people in the Billings area. Through a cooperative agreement with the DFWP, Lake Josephine will be managed by the City of Billings Recreation Department.

CONCLUSION

The seven additions described above were made possible by the coal tax trust fund. As Montanans respond to the new opportunities provided by House Bill 550, this fund will continue to build a state park system of benefit to all who live in and visit Montana.

Criteria For Park System Components

STATE PARKS

Purpose:

To provide high-quality recreation experiences distinctive and notable enough to attract people on a state, regional or national basis.

Description:

Open-space areas of unique scenery or other outstanding natural features of an aesthetic, historical, geological, archaeological or scientific nature. State parks will be selected on the basis of these inherent characteristics without regard to geographic location.

Development and Management:

Development of roads and desirable facilities will be planned with precise and sensitive regard for all natural features and without impingement upon the visitors' aesthetic and intellectual sensibilities. Management will be directed toward retention of state parks in as near a natural condition as possible, without impairment of ecological features and values.

STATE RECREATION AREAS

Purpose:

To provide a broad selection of outdoor recreation opportunities in a natural setting which may be used by large numbers of people.

Description:

Contain natural or artificial resources which provide outdoor recreation opportunities that will attract visitors from beyond the local area. They may be located in areas which have serious deficiencies in public outdoor recreation facilities, provided that such recreation areas should not be furnished in lieu of municipal, county or federal facilities.

Development and Management:

Protection of the natural environment and aesthetic qualities should be paramount except development for intensive use may require alteration of the natural environment. However, the aesthetic qualities of the areas will be retained to the greatest degree possible by careful planning and construction of facilities.

STATE MONUMENTS

Purpose:

To preserve, protect and enhance objects, features or places of historical, geological, archaeological or scientific importance, including commemoration of outstanding persons or events.

Description:

Sites of optimum form and size for the protection and enhancement of the objects, features or places concerned, including adequate space for parking, if appropriate, and other accommodations for anticipated day use.

Development and Management:

Standard constructions will be facilities for providing access, parking, sanitary conditions and water. Other service facilities may be added if required. Overnight camping will ordinarily not be allowed. Development may also include restoration of historical structures and installation of protective devices. Maximum benefit to visitors may be achieved by providing museums, outdoor dioramas and other interpretive exhibits.

STATE FISHING ACCESS SITES

Purpose:

To provide permanent, public access to high-quality rivers, streams and lakes.

Description:

Areas adjacent to high-quality fishing waters accessible by an existing or acquired public right-of-way and of adequate size to permit practical use of the waters concerned for fishing and, when appropriate, other water-based recreation.

Development and Management:

Accommodations will consist of facilities for day use and, in certain cases, overnight camping. Boat-launching ramps, road building and fencing may be necessary. Management will involve proper identification of the site and maintenance of public right-of-way and service facilities.

STATE RECREATIONAL WATERWAYS

Purpose:

To protect and enhance the natural and historical values of state waterways and to provide opportunity for enjoyment of these values.

Description:

Rivers or streams, generally undeveloped, possessing outstanding scenery and/or important historical features and susceptible to increasingly heavy recreational use.

Development and Management:

Accommodations for day use, camping, floating, fishing or other recreational activities will be provided. Public areas for lunch stops and overnight camping will be conveniently distributed along the course such that they will permit leisurely floats from one area to the next in four hours or less. Development will also include wells for drinking water where necessary. Management will primarily involve maintenance of public areas and identification of sites and points of historical or geological interest for visitors.

STATE RECREATION ROADS AND TRAILS

The Dept. of Fish, Wildlife and Parks believes that the scenic and cultural attributes of certain Montana roads and trails are of high recreational value and warrant formal protection against uncontrolled use and development.

Preparation of criteria for state recreation roads and trails is in progress, along with other plans for this valuable expansion of the state park system. ■

Contributors

When early summer thoughts turn to outdoor recreation possibilities, chances are a hillside where you picnicked last summer, or an area that depicts Montana's colorful history, or one that provides access to a favorite fishing stream come to mind. Ask yourself: Would one of these areas be an appropriate component of our state park system? If the answer is yes, "Nominate Your Favorite Park." In 1979, the Montana Legislature passed a bill which allows "any person, association, or representative of a governing unit" to submit a proposal for acquisition of an area to be added to the state park system. The source of funds for these new recreation areas is the trust fund from Montana's coal tax. **Terry Knupp** outlines how to submit proposals and what kinds of areas qualify and provides some details about seven areas acquired from the coal tax trust fund. Knupp joined the department in October 1979 as state planner for the Parks Division. A Bozeman native, she enjoys cross-country skiing, hiking and other outdoor activities. Turn to her article on page 2.

Aldo Leopold called "Falconry: A 'Perfect Hobby'." Montana's small, but dedicated, group of falconers agrees. Assyrian paintings indicate falconry dates back almost 4,000 years and the sport was referred to in Homer's "Odyssey" and Aristotle's "History of Animals." As **Ralph Rogers** and **Mac Roberts** write, "Hunting with hawks and falcons evolved as a means of gathering food, and was used by many early cultures." Although falconry is still considered a hunting sport, Rogers and Roberts point out the primary motive of any falconer is to train and watch his bird in flight—the taking of game becomes secondary. Rogers teaches biology in Winifred and has done graduate work on migratory peregrine falcons in Texas. He has been practicing falconry for 18 years and belongs to the North American Falconry Association and the Montana Falconry Association. Roberts has been employed by several state and federal agencies and has worked toward adoption of laws protecting birds of prey and regulations concerning the legal practice of falconry in Montana. He is past vice president and secretary-treasurer of the Montana Falconry Association. Turn to their article on page 11.

The area is characterized by cascading water, gentle breezes brushing through the trees, vertical limestone cliffs, brightly colored lichens and pine-scented air. **Steve Joppa** calls it one of Montana's "most spectacular and scenic areas." Natural Bridge State Monument is situated about 28 miles south of Big Timber. During high water, the Boulder River flows over a 100-foot precipice, creating a majestic falls. But during low water, the water disappears into a subterranean channel about 200 feet upstream. When this happens, "Nature's Bridge" appears—a natural rock bridge across the river channel. The site also has parking facilities, foot trails and information signs explaining the area's geology, and a man-made foot bridge providing easier access to about 5,000 acres of public land. Joppa works as a civil engineer for the department's Parks Division. Turn to his article on page 14.

The word "scorcher" could have originated when someone spent an August afternoon on the eastern Montana prairie. Yet on such an afternoon, **Al Elser** and Dr. Norman Schoenthal were out sampling fish in O'Fallon Creek. The heat suddenly seemed less stifling when, in the usual assemblage of prairie fishes, a killifish turned up. The find was significant because the killifish had previously been documented in the state only in the Bighorn River Drainage. They prefer streams with alkaline or saline water which have little appeal for other fish species. Elser suggests their distribution is limited because they require saline water, or because they can't compete with more diverse fish populations. Of what value are they? Elser emphasizes they are part of the lower Yellowstone River's integrity. But most important, he writes, the plains killifish "is important because it is." Well known for his research on paddlefish, Elser is the department's fishery manager for the Miles City region. He is president of the Montana Chapter, American Fisheries Society. "In Search of Native Killifish" begins on page 25

The killifish and "Docile Dinosaur" (page 29) articles are ably illustrated by Butte artist **Harvey Eckert**. His work first appeared in *Montana Outdoors* in the March/April 1980 issue, illustrating "Exotic Introductions: A Fishery Manager's Headache." His illustrations have enhanced the pages of many national publications, including *Fly Fisherman, Fishing World, Fly Tyer*, "United Fly Tyer's Almanac," as well as other books and magazines. Eckert is employed at Fran Johnson's Sports Shop in Butte.

"Docile Dinosaur" isn't a story about prehistoric beasts that roamed across Montana. It is, instead, the tale of the salmon fly, so called because of the orangish-pink coloring of its underbelly. Compared with its cousins in the insect world, the salmon fly grows very old and very large. It is less than speedy and agile, in an environment where those things count. It lacks almost every adaptation for life in fast-moving water. Yet, as **David Quammen** writes, ". . . it makes its home and does its business in the fastest, heaviest current." In faraway places, summer vacations are planned to coincide with its hatch. But nobody—including professional studiers of such things, entomologists—knows much about it. Its natural history and biology is a mixture of mystery, scattered facts and plain conjecture. But turn to page 29 and you'll find that reading about the "marvelous little beast" is fun. Quammen is a free-lance writer living in Ennis. He served as editorial consultant at *MO*, for the Jan./Feb. 1980 magazine and also for our Special Hunting Issue.

Undeniably, Montana is nationally known for its vast fish and wildlife resources—and also for its tremendous energy reserves. Therefore, the potential conflict between fish and wildlife values and large-scale energy development is not hard to imagine. As **Ken Knudson** and **Larry Peterman** write, ". . . it boils down to one word: *habitat*." Their article not only traces the evolution of energy problems and analyzes some of the impacts of meeting energy demands, but it also offers alternatives designed to minimize energy impacts to Montana's fish and wildlife heritage. They point out that continuing on the development path of the past 20 years will not be productive—for the consumer's pocketbook or for Montana's fish and wildlife resources. Turn to "Wildlife and Energy Development: Montana's Future Options" on page 31. Knudson and Peterman both work in the department's Ecological Services Division. Knudson is the pollution control biologist; he has been with the department since 1974 and previously worked for the Texas Parks and Wildlife Department. Peterman is the department's water resources supervisor. He is working with in-stream flows and monitoring water development projects. He previously was aquatic project leader for the department's study on the Yellowstone River.

Special thanks to **Larry Thompson** of Helena are long overdue. His pen-and-ink illustration of *Calypso bulbosa*—more commonly called fairyslipper—accompanies "The Editor's Column" in this magazine. His observant eye and careful pen have accurately captured many pleasing images which have previously appeared in these pages.

The Catchall

Some That Didn't Get Away . . . (and one that did)

Four Montana fishing records were broken in 1979—bigmouth buffalo (see the following story), lake trout, pallid sturgeon and squawfish—and the smallmouth buffalo was added to the "Fishing Records Summary."

In order to be included on the state records list, we require that the fish (1) be legally harvested, (2) be weighed on an inspected scale (most grocery store scales are certified and inspected) and (3) be positively identified. To maintain the list's integrity and to protect current record holders, we ask that a record fish be documented and verified by department personnel *whenever possible*. If a department employee is unavailable, the angler must present a photograph from

1979 Fishing Records Summary

Species	Weight lbs.	Weight ozs.	Angler	Year	Location
Bigmouth buffalo*	**32**	**6**	**Gary Lundman**	**1979**	**Missouri River (Slippery Ann Game Station)**
Black bullhead	1	11	Mike Mitchell	1977	Horse Creek (McCone Co.)
Black crappie	3	2	Al Elser	1973	Tongue River Reservoir
Bluegill	2	8	George Schlosser	1967	Dengel Reservoir
Brook trout	9	1	John R. Cook	1940	Lower Two Medicine Lake
Brown trout	29	0	E. H. "Peck" Bacon	1966	Wade Lake
Burbot (ling)	12	9¾	Tom Colgan	1977	Missouri River
Channel catfish	22	6	Robert Opp	1978	Yellowstone River
Coho salmon	4	14	Irven Stohl	1973	Fort Peck Reservoir
Cutthroat trout	16	0	William D. Sands	1955	Red Eagle Lake
Dolly Varden	25	10	James Hyer	1916	Unknown
Drum	13	6	George Gallagher	1973	Fort Peck Reservoir
Golden trout	2	9	Raymond D. Gallik	1975	Lightning Lake
Goldeye	2	9	Lester Estenson	1977	Nelson Reservoir
Grayling	2	10	Mark Daniels	1974	Handkerchief Lake
King salmon (chinook)	4	7	Berry Gillis	1972	Missouri River
Kokanee salmon	5	15	Forrest Johnson	1976	Pishkun Reservoir
Lake trout*	**42**	**0**	**Dave Larson**	**1979**	**Flathead Lake (east shore)**
Lake whitefish	4	7½	Jim Frame	1978	Echo Lake
Largemouth bass	7	6	Jere Hightower	1973	Ninepipe Reservoir
Mountain whitefish	4	9¾	Mike Hangas	1977	Blackfoot River
Northern pike	37	8	Lance Moyler	1972	Tongue River Reservoir
Paddlefish	142	8	Larry Branstetter	1973	Missouri River
Pallid sturgeon*	**60**	**0**	**Gene Sattler**	**1979**	**Yellowstone River**
Rainbow trout	20	0	C. J. Brohaugh	1952	Cliff Lake
Rainbow-cutthroat hybrid	17	10	R. A. Rousselle	1973	Ashley Lake
Sauger	7	2	Raymond V. Johnston	1975	Tongue River Reservoir
Shortnose gar	3	1	John Johnson	1977	Fort Peck Dredge Cuts
Shovelnose sturgeon	12	12	Troy Sidewell	1978	Marias River at Loma
Smallmouth bass	4	11½	Bob Higson	1975	Horseshoe Lake
Smallmouth buffalo**	9	4	Mac McKinney	1977	Hauser Lake (west side)
Squawfish*	**6**	**10**	**Rick Norris**	**1979**	**Flathead Lake (Polson Bridge)**
Walleye	14	0	Neil Berg	1974	Nelson Reservoir
White crappie	2	2	Drew Jackson	1978	Tongue River Reservoir
White sturgeon	96	0	Herb Stout	1968	Kootenai River
White sucker	3	7	Jim Crants	1978	Nelson Reservoir
Yellow perch	2	0	Gerald Pottratz	1974	Nelson Reservoir

*New Montana records for 1979

**New species added to Montana fishing records in 1979

recycled paper

which the fish can be properly identified. However, identification by photograph is difficult with some species.

* * * * *

Among the Montana fishing records shattered in 1979 was that for bigmouth buffalo (*Ictiobus cyprinellus*). Gary Lundman of Havre took the 32-pound, 6-ounce fish on a hook and line on the Missouri River near the Slippery Ann Game Station. The old record of 25 pounds, 3 ounces was set by Gaylord Hagen in 1977 at the Fort Peck Dredge Cuts. Department fishery biologist Mike Poore, Lewistown, verified the species' identification and weight.

Bigmouth buffalo are the largest and, commercially, the most important members of the sucker family in North America. They feed on the bottom and strain insect larvae, algae and other small plants and animals (plankton) with their long gill rakers. They do not usually take bait and are infrequently caught by anglers.

Two species of buffalo inhabit Montana: The other is the smallmouth buffalo (*Ictiobus bubalus*). Both species are native and prefer the lower reaches of the Yellowstone and Missouri rivers in eastern Montana.

The flesh of the bigmouth buffalo is tasty, and buffalo steaks sell for about $1.98 a pound. Bigmouth and smallmouth buffalo make up over half of Montana's commercial harvest; annually, about 400,000 pounds are taken out of Fort Peck Reservoir, with most going to California markets.

Commercial fishermen at Fort Peck Reservoir have reported a few 30-pound buffalo. Fishery biologists conducting research caught a 36-pound bigmouth in the Big Dry Arm of Fort Peck Reservoir in 1966 and researchers netted, tagged and released a 34-pound specimen at Nelson Reservoir near Malta last summer. The world angling record weighed 56 pounds and was caught in Lock Loma Lake, Mo. The heaviest bigmouth buffalo known to science was an 80-pounder taken at Spirit Lake along Iowa's northern border.

* * * * *

We've all heard tales about big fish that got away. The Department of Fish, Wildlife and Parks can back up one of them.

Two department fishery biologists, Phil Stewart and Kent Gilge, working on the Missouri River near the mouth of the Poplar River in the state's northeastern corner, shocked up a 16-pound, 8-ounce burbot. The fish was 3 pounds, 14¼ ounces heavier than the state record and measured 42 inches long. It had a #2 hook and a wire leader hanging from its lower jaw. After the biologists weighed, measured, tagged and photographed it, they returned it to the Missouri—in good condition.

Frank Gjersing, a department biologist in Havre, holds a 7-pound, 2-ounce largemouth bass caught by Jon Goodman on July 17, 1979, near White Bear Reservoir on the Fort Belknap Reservation. As far as department records show, this big bass is the largest ever caught in northeastern Montana. It is 4 ounces shy of the state record of 7 pounds, 6 ounces caught by Jere Hightower in 1973 in Ninepipe Reservoir near Ronan in western Montana (DFWP photo: Mike Aderhold).

The Montana record burbot weighed 21 pounds, 9¾ ounces; the fish was caught by Tom Colgan of Poplar in March 1977. He caught his record fish within 100 yards of where biologists netted the 16-pounder.

The burbot (also called ling or ling cod) is native to Montana. It is the only freshwater representative of the codfish family (haddock, hake, pollack) found in North America. With its brown and yellow marbled coloring and a well-developed single barbel or "whisker" on its chin, this eel-like fish is easily recognized and remembered.

It's a tasty fish which has generated quite a bit of interest in several parts of Montana—especially in areas with ice fishing. The Missouri and Yellowstone rivers; Fort Peck, Clark Canyon and Tiber reservoirs, and Lake Frances southwest of Shelby are well-known "hot spots." The state legislature classified the burbot as a game species but there is not yet a daily or possession limit.

The unofficial national record is a 19-pound, 4-ounce ling caught in 1965 at Pilot Butte Reservoir in west central Wyoming.—*Mike Aderhold, Region 6 (Glasgow) information officer*

Conserving Fuel While Fishing

The American Fishing Tackle Manufacturers Association offers the following suggestions to help anglers conserve fuel while fishing:

(1) Form a car pool with neighbors and friends. Four can drive on about the same amount of fuel as one.

(2) Find out what public transportation is available to outdoor recreation areas.

(3) Check with local independent school bus operators. Many will accept weekend charters, especially during the summer.

(4) Fish closer to home. Look for spots previously not considered and which require less travel to reach.

(5) Check into the possibility of renting a boat and trailer near your destination rather than hauling them. Your automobile will get much better gas mileage when it is not pulling a load.

(6) Fish more days when on location, thus taking fewer trips.

(7) Think about specific fishing locations. Plot the lake or stream that would result in the least use of a motor.

(8) Use the smallest practical boat, such as a rowboat or canoe.

(9) Match the motor to the boat and

keep the motor tuned and in proper operating condition.

(10) Make sure the motor is properly mounted, the propeller is in good shape and the boat bottom is free of algae.

(11) Check instructions for proper oil mix for the motor, or check with your dealer about alternatives that might be available.

(12) Pour fuel carefully; don't waste any or pollute the water.

(13) Don't idle the motor unnecessarily and drift fish where possible.

(14) Throttle back. A reduction in power results in a substantial saving on gasoline.

(15) Balance the boat properly when loading it and keep weight to a minimum. Do not overload the boat beyond its capacity, even to save gasoline.

(16) Use electric motors as much as possible.—*Sport Fishing Institute Bulletin*

The 32-Pound Snapper of Redwater River

Ken Buechler with a 32-pound friend (DFWP photo: Mike Aderhold).

On an August morning last summer, Richey farmer Ken Buechler and a companion, Jeff Eggert, found a 32-pound snapping turtle in the Redwater River, a tributary of the Missouri River southeast of Wolf Point. Buechler put the turtle in a small stock tank with food and water and showed it to friends in Richey and Vida. Over 100 people came to see the animal—few had ever seen a snapping turtle before and nobody had ever seen one that large. Buechler returned the turtle to the Redwater.

Found in every state east of the Rocky Mountains and in parts of southern Canada, the common snapping turtle (*Chelydra serpentina serpentina*) is the most widely distributed turtle in North America. But little is known about its distribution in Montana. It is thought to be common in the lower Yellowstone drainage from about Forsyth east and several have been seen along the lower Tongue River near Miles City. The animal is apparently rare in the northeastern corner of the state. Bob Needham, fishery manager for Region 6 (Glasgow) for the last 14 years, had never observed a snapping turtle in the Missouri drainage. Project fishery biologist Phil Stewart, who has studied the Poplar River and lower Missouri for almost four years, reports he has never seen a snapper in those waters.

Thirty-two pounds is large for the species, but a 40-pounder was found at the Lacreek National Wildlife Refuge (NWR) in South Dakota and one weighing 68 pounds was documented at the Valentine NWR in northwestern Nebraska. Snapping turtle expert Donald Hammer wrote of an 86-pound captive snapper in a 1971 article in *Natural History*. Most adults probably weigh between 10 and 20 pounds.

Snapping turtles prefer shallow water, from two to six feet deep, along lake margins and permanent marshes. They feed mainly on fish and aquatic vegetation, but will eat just about any small animal including snakes, frogs, salamanders, snails, insects, waterfowl and aquatic mammals.

Its slow, sluggish appearance belies a lightning fast lunging and striking capability and an aggressive nature when threatened. Buechler noted that when he and Eggert first found the animal, it would charge them when they got closer than about 10 feet.

Snapping turtles are sometimes described as appearing too small for their shells. They have a small, narrow lower shell (plastron) that, unlike shells of other turtles, is only one-third the size of the top shell (carapace). They also have powerful looking heads, hook jaws and unusually long tails with saw-toothed crests.

During winter, snapping turtles hibernate in bottom mud and plant debris. They emerge after the ice clears in April or May. Nesting takes place in June, usually after the sun goes down and often during rainy weather. The female prefers disturbed areas relatively free of vegetation, such as fallow fields or roadside borrow areas near water. The clutch averages about 50 soft-shelled eggs slightly smaller than a ping-pong ball. The eggs are buried and the incubation (by sunlight) takes 70-120 days depending on soil temperature. The new turtles emerge in fall and mortality is high for several years until they reach a weight of four or five pounds.

Some biologists believe the turtle form may date back 200 million years. The form is so successful that mature snappers

may be among the very few wild animals to reach old age—which for a free-living snapping turtle is about 25 years.—*Mike Aderhold, Region 6 (Glasgow) information officer*

Department Offers Varied Movies

Next to actually being on the scene, no other medium is as effective in bringing you there as a well-produced, color, sound movie. In fact, a movie often has advantages over actual experience, since the observer can sit in comfort and safety and look at what might be a dangerous or uncomfortable situation.

The Montana Department of Fish, Wildlife and Parks Film Center maintains a free film library with over 85 titles. Subjects range from wildlife, predators, hunting, boat safety and snowmobiling to waterfowl identification, game birds, environmental abuses and pollution.

To receive a complete list of films or to order a particular movie, call or write the Department of Fish, Wildlife and Parks, Film Center, 930 Custer Ave. W.; Helena, MT 59601 (406-449-2426). Regional offices in Kalispell, Bozeman, Billings, Missoula, Great Falls, Glasgow and Miles City can also assist you in obtaining a film.

Due to the heavy demand on certain films, order your choices as far in advance as possible; include alternate dates and titles. Return postage must be paid by the user of the films.—*Tom Warren, Film Center manager*

"Go Lightly on the Land"

Wilderness is one subject guaranteed to generate controversy, even among those who are kindly disposed toward it. Take, for example, the friendly (and sometimes not so friendly) debate between horsemen and backpackers.

Backpackers believe that walking is the only way to go—it's quieter, cleaner, cheaper and it doesn't disturb wildlife. They also maintain that backpacking results in fewer environmental impacts—less trail erosion, campsite compaction and vegetation damage.

Horsemen, on the other hand, counter with the argument that proper handling of stock does not harm the environment. They believe horses allow people to use wilderness who otherwise wouldn't be able to do so. Besides, for one reason or another, some people simply aren't too fond of walking (eight years in Uncle Sam's infantry made a confirmed horseman of me).

In truth, backpackers and horsemen must learn to coexist, because wilderness needs both groups' support. Horsemen must take care to reduce the impact of their stock in the backcountry, and backpackers must understand that they can pose a safety hazard to horsemen. A brightly colored pack, a flapping poncho or a quick move is enough to send even the most docile trail horse leaping off the side of the mountain.

Let me cite an example. While returning from a hunting trip, some horsemen friends of mine met some backpackers on the trail. The backpackers politely stepped off the trail, but on the uphill side. The riders dismounted, also politely, to converse with the hikers. As one hiker tried to sit down along the trail, he slipped under a horse. Luckily for him, the horse kicked instead of rearing.

But it was unlucky for my friend, because he caught both of the horse's hind feet in the center of his chest. The impact separated his rib cage from his sternum. He is lucky to be alive. So is the backpacker, who could have just as easily been injured or killed by the horse.

A few do's and don't's are in order for riders and hikers alike. The paramount concern of both groups should be safety—their own and the other person's. The way to accomplish this is to be courteous and be considerate at all times.

For the horseman:

•Announce your presence when approaching a group of hikers. If you startle them, they're going to startle the horses. Dismount to talk to them.

•Understand and appreciate the energy a backpacker must expend to visit the backcountry. Offer assistance if and when appropriate.

•Use horse shoes without calks and stay on established trails.

•Respect the wilderness: Use light equipment; limit your stock.

For the backpacker:

•For safety reasons, horses have the right-of-way on trails. Step off the trail on the downhill side and remain motionless. If you have a dog, hold on to it.

•As horses pass, or while you're visiting with the riders, don't try to touch or feed the animals.

•Remember, anything strange, new or different can spook a horse, and the results can be disastrous.

•Camp well away from established trails.

•Hang rain flies for tents and clothing or any flapping material out of view of the trail.

Education is the key to reducing user conflicts in the backcountry. The Missoula Backcountry Horsemen, a group of horse enthusiasts from the Missoula area, is producing a slide show for the U.S. Forest Service on proper horse use in the backcountry, to be titled "Go Lightly on the Land." The show and tape will be available to the public to provide further information about how horses can be used with minimal impact on the country.—*Tom Bryant, Supt. for Recreation, City of Missoula*

FALCONRY: A "Perfect Hobby"

by Ralph Rogers and Mac Roberts

WHETHER YOU ARE a trained wildlife biologist or a weekend pheasant hunter, you have probably been thrilled by the sight of a hawk or falcon in pursuit of its prey. Montana's falconers, a small but dedicated group of sportsmen, are able to witness this phenomenon regularly.

Although falconry is considered a hunting sport, the primary motive of any falconer is a desire to train and watch his bird in flight; thus, the actual taking of game becomes secondary. Almost any other form of hunting is more efficient if one considers the number of game birds or animals killed as the yardstick of efficiency. While modern falconers do not fly their birds solely to place game on the table, this has not always been the case.

Hunting with hawks and falcons evolved as a means of gathering food, and was used by many early cultures. Assyrian bas-relief paintings showing men and trained hawks suggests that falconry dates back almost 4,000 years. Homer alluded to falconry in the "Odyssey," and Aristotle specifically mentioned falconry in his "History of Animals" in about 350 B.C. Falconry flourished for centuries in ancient Asia where, in the 13th century, Genghis Khan enlisted the help of goshawks in securing fresh meat for his soldiers.

Following the advent of gunpowder and the subsequent development of firearms, the popularity of falconry as a practical means of taking game declined. But falconry as a sport continued to flourish in the royal courts of Europe until about the 17th century. The type of hawk or falcon a person could possess in early England was dictated by his "station"—for example, a king could have an eagle or gyrfalcon; an earl, a peregrine; a peasant, a kestrel, and so on. Although falconry is still practiced in the British Isles, the difficulty in obtaining birds and the expense involved in hunting of any type make falconry a pursuit for the wealthy. Nonetheless, it is comforting to know that falcons are still being flown at red grouse over the moors of Scotland, as they have been since antiquity.

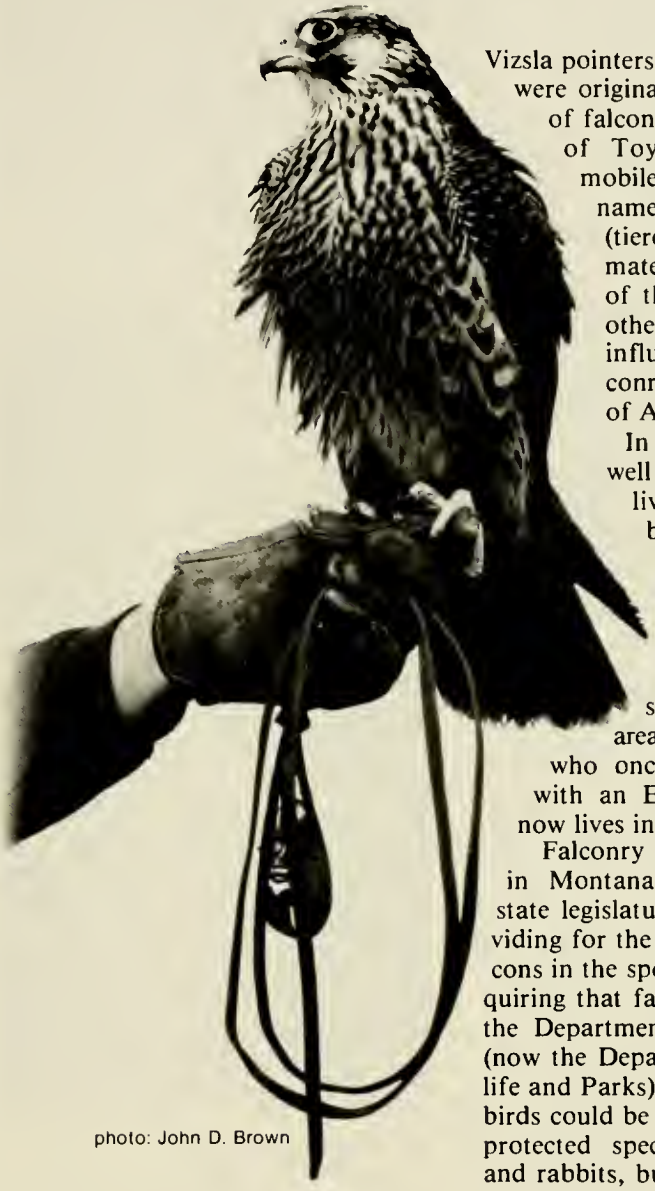


photo: John D. Brown

Although few Americans realize it, falconry has had subtle influences on our culture. For example, when you last referred to someone as an "old codger," did you realize you were insinuating that he was too old to actively participate in falconry, but should instead be given the chore of carrying the "cadge" or field perch for the hawks? Do the owners of Vizsla pointers realize their bird dogs were originally bred for the sport of falconry? Do the purchasers of Toyota "Tercel" automobiles know their car is named for the male falcon (tiercel), which is approximately one-third the size of the female? These and other direct and indirect influences have made falconry an interesting part of American culture.

In past decades, several well known falconers have lived and flown their birds in Montana. The late Colonel Luff Meredith, known to many Americans as "the father of modern falconry," resided in the Augusta area. Dr. John Craighead, who once practiced falconry with an East Indian maharaja, now lives in Missoula.

Falconry acquired legal status in Montana in 1971, when the state legislature enacted a law providing for the use of hawks and falcons in the sport of falconry and requiring that falconers be licensed by the Department of Fish and Game (now the Department of Fish, Wildlife and Parks). Before that time, the birds could be kept and flown at unprotected species such as pigeons and rabbits, but could not be legally used to take game species.

In 1977, the department adopted federal guidelines for the registration and keeping of hawks and falcons. These regulations require that each bird wears a numbered, nonremovable plastic leg band issued by the U.S. Fish and Wildlife Service and that falconers' facilities and equipment be inspected. A falconry license can now be obtained only by passing a written examination relating to the behavior, biology and care of hawks and falcons. These more stringent federal guidelines were developed and instituted largely

at the urging of falconers themselves, who felt an ethical responsibility to stop the illegal trafficking in hawks which had taken place in previous years.

HUNTING WITH HAWKS AND FALCONS

In the strictest sense, falconry is divided into two areas of participation, depending on the type of bird used. Those who hunt with falcons are considered *falconers*, and those who hunt with hawks or eagles are considered *austringers*. The division is a logical one based on the birds' instinctive hunting techniques.

Hawks are often seen in the wild sitting in dead trees or on fence posts, using their superior vision to detect any movement by prey. The austringer, then, becomes an active participant in the hunt, with his bird perched on gloved fist. When the prey flushes, the hawk explodes into flight, taking advantage of its greater speed and maneuverability to grasp or "bind" to its prey, riding it to the ground where it can be killed. Hawks do not, as is commonly believed, retrieve their prey. Rather, the austringer is led to his hawk by the ringing of special bells attached to the bird's leg or tail.

On the other hand, wild falcons frequent open areas where they can soar at high altitudes searching for prey, a trait the falconer takes advantage of while hunting. The falconer relies on a pointing dog to locate and hold the game, then releases his falcon. Trained falcons know the meaning of a pointing dog, and quickly climb high overhead. When the falcon reaches its highest point (pitch), the game is flushed; the falcon then folds its wings, and begins a rapid dive (stoop). Sometimes the falcon strikes its prey in midair, and sometimes it binds to its prey, riding it to the ground, where it uses its notched beak to sever the prey's cervical vertebrae. It is this breathtaking stoop, in which the falcon may achieve a speed of 200 miles per hour, that most motivates the falconer. If he sees it, regardless of whether the prey has been captured, his day has been a success.

One of the thrills of falconry is observing the evasive techniques of game birds. Falcons prefer to prey upon other birds, rather than on

A captive-bred falcon (above photo: Rudy Stulc) has just taken a sharp-tailed grouse, one of Montana's managed game bird species. Prairie falcon (below DFWP photo: Louis Kis). Falcons prefer to prey on other birds, rather than on mammals.

mammals. The higher a falconer's bird flies while hunting, the better the bird is said to have performed. A falconer may increase the height to which his bird will climb by choosing the right game bird and the proper terrain. In an attempt to achieve the perfect flight, the falconer will pick a game bird which, because of its nature or the lack of ground cover, will try to outfly the falcon, rather than elude it on the ground. If a falcon is outflown, it will respond by climbing higher the next time. If the game bird eludes the falcon by landing in cover, the falcon realizes its altitude has been a disadvantage and will not climb as high on subsequent flights.

More often than not, the game bird escapes: The pheasant makes it to cover, the sharp-tailed grouse performs three barrel rolls, an inside loop and a half-gainer flawlessly at top speed or, heaven forbid, the dog was pointing a seven-pound sage grouse which now flies out and shakes its "fist" at falcon and falconer alike. A Colorado Division of Wildlife study found that it takes 9.1 hours of hunting to kill one small game animal with a hawk of any kind. This, of course, does not take into consideration the endless hours of care necessary in the off-season when the hawk cannot be hunted on game species . . . or the midnight forays after pigeons to feed the bird . . . or the time spent explaining what that white stuff is on the carpet. Good falconers never tally it all up, it's just part of the deal—time spent without thought on the sport they love.

MODERN FALCONRY

Although most falconers respect the traditions of their sport and attempt to keep it as unchanged as possible, a few concessions have been made to the 20th century. One of the most significant has been the use of biotelemetry in tracking lost hawks and falcons. A tiny transmitter, weighing no more than the traditional bell, is affixed to the bird. If for some reason the bird wanders beyond the control of the falconer, it can be located by tracking the transmitter's signal. Many birds have been recovered using this technique. Radio tagging has also led to the discovery that hawk shooting still poses a threat to birds of prey in Montana. Birds have been shot and simply thrown into the ditch still wearing the radio equipment. The pain and frustration a falconer feels under such circumstances is indescribable.

On a less somber note, other recent changes have greatly enhanced the sport of falconry in Montana. In August 1979, the Montana Fish and Game Commission voted to allow the state's falconers an extended hunting season, joining at least 24 other states in so doing. Experience in other states indicates that such seasons cause few administrative, enforcement or management problems.

Falconers need an extended hunt-

The goshawk (above photo: Alan Abramson) is an efficient predator of the northern woodlands. The American kestrel or sparrow hawk (right DFWP photo: Mike Aderhold) is frequently used by beginners in learning the art of falconry.

ing season because of the time it takes to capture and train their birds. Most falconers use wild birds, which they cannot legally trap prior to Sept. 6 (about the time the regular gun season for some game birds opens). Assuming a falconer can catch a falcon the first day possible, he must then tame, train and physically recondition it, all of which takes approximately nine or 10 weeks. This would leave him only a few weeks in which to hunt during the regular gun season. The extended season (open until March 31 in 1980) provides the falconer an adequate opportunity to hunt with his bird after its training is completed.

In addition to maintaining the quality of falconry as a hunting sport, modern falconers believe they owe something to the birds themselves, for the endless hours of enjoyment they provide. For that reason, falconers have been taking an increasingly active part in the management of raptors (birds of prey). It was the dream and actions of a falconer named Morlan Nelson that subsequently resulted in formation of the Snake River Birds of Prey Natural Area.

Other falconers, such as Dr. David Remple, are involved in the sort of work that recently succeeded in rehabilitating a botulism-poisoned peregrine, resulting in its release back into the Montana wilds (see Bill Pryor's article in "The Catchall," *Montana Outdoors*, Jan./Feb. 1980).

Finally, the Peregrine Fund, administered and managed almost exclusively by practicing falconers, has made great strides in the propagation of raptors in captivity. Peregrine falcons from the Peregrine Fund at Cornell University are laying eggs in eyries (nests) east of the Mississippi for the first time since the mid-'50s, when DDT caused their extirpation over the region. In the West, captive peregrines at the Peregrine Fund facility in Fort Collins, Colo., and other independent breeding facilities have greatly outproduced remnant populations of wild peregrines in recent years. Some of these birds produced in captivity are used to supplement occupied, though failing, peregrine eyries, while others are cross-fostered into prairie falcon eyries, a technique in which prairie falcon chicks are replaced by peregrine falcon chicks (see Dennis Flath's article in the Jan./Feb. 1980 issue of *Montana Outdoors*). A few captive peregrines are loaned to highly qualified falconers, who teach them to hunt; when these birds reach reproductive age (about two years), they are released into the wild near suitable nesting habitat.

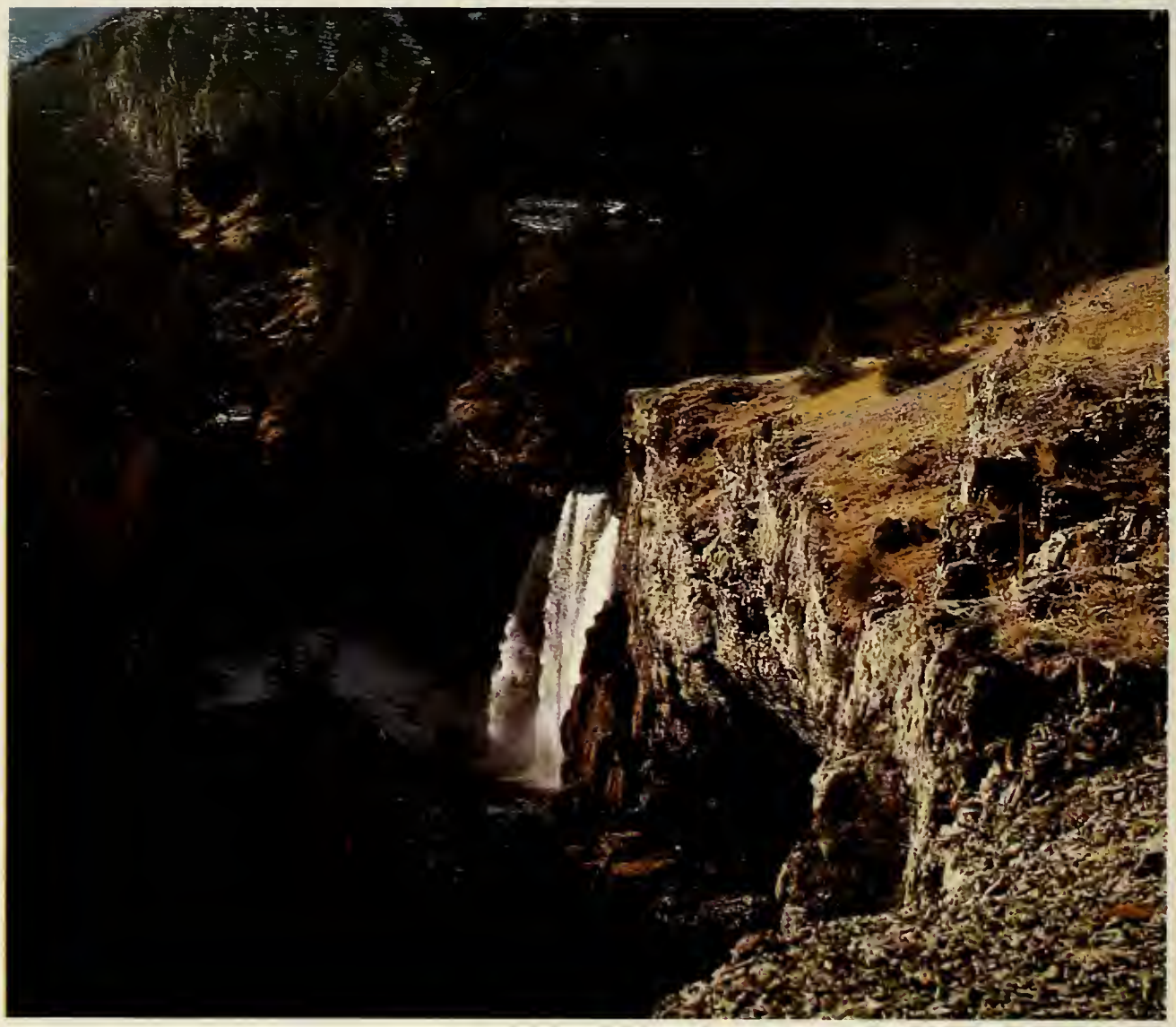
With the production of raptors in captivity, extended hunting seasons and a better public understanding of the sport of falconry, we hope this time-honored activity can continue indefinitely. That it is a worthwhile pursuit has been recognized by many people, including Aldo Leopold, who expressed his feelings about falconry in "A Sand County Almanac with Essays on Conservation from Round River":

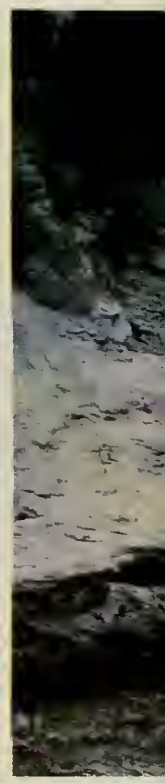
> The most glamorous hobby I know of today is the revival of falconry. It has a few addicts in America, and perhaps a dozen in England—a minority indeed. . . . The hawk, as a lethal agent, is the perfect flower of that still utterly mysterious alchemy—evolution. No living man can, or possibly ever will, understand the instinct of predation that we share with our raptorial servant. No man-made machine can, or ever will, synthesize that perfect co-ordination of eye, muscle, and pinion as he stoops to his kill. . . . Moreover the hawk, at the slightest error in technique of handling, may either "go tame" like *Homo sapiens* or fly away into the blue. All in all, falconry is the perfect hobby.

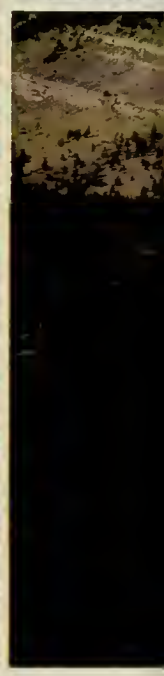
We would like to close with the timeless admonition of all falconers: *Please don't shoot hawks!* ■

NATURE'S BRIDGE

by Steve Joppa



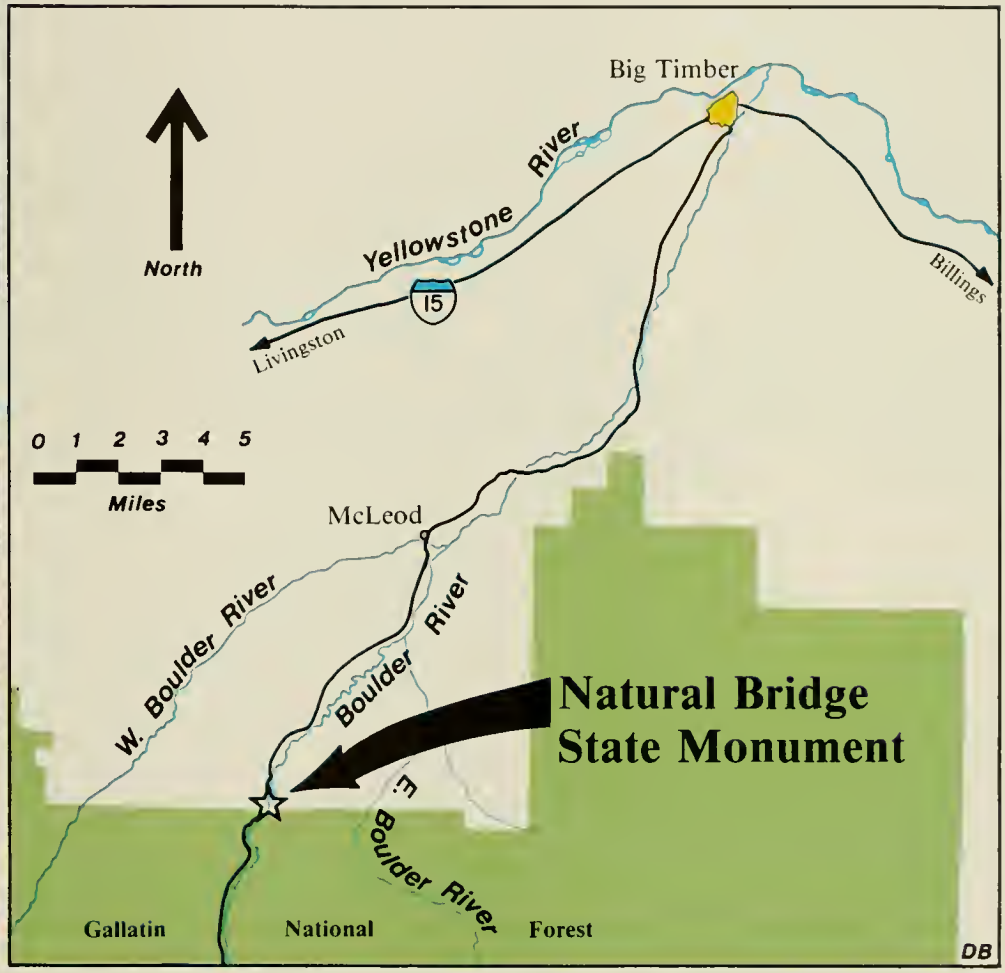




THE SOUND OF cascading water, the breeze brushing through pine trees, vertical limestone cliffs, colorful lichens, pine-scented air—one of the most spectacular and scenic areas in Montana has all of these attributes.

Natural Bridge State Monument (above photo: DFWP) is situated on the Boulder River approximately 28 miles south of Big Timber (see map). Constrained by a deeply cut chasm, during high water the river flows over a 100-foot precipice, creating Boulder River Falls. During low water, the water disappears into an underground channel about 200 feet upstream from the falls. When this happens, a natural rock bridge across the river channel is revealed (top middle photo: Joe Gutkoski, U.S. Forest Service).

In 1977, the Department of Fish, Wildlife and Parks, in cooperation



with the U.S. Forest Service, contracted to construct roads, parking facilities, foot trails and information signs explaining the area's geology. Work was completed in spring 1978.

In 1979, a contract was let to construct a footbridge, designed by HKM Associates of Billings, across the chasm (lower middle DFWP photo: Steve Joppa). The 110-foot span is made of two massive glue-laminated wooden beams and has a wooden deck. A stile at the bridge's entrance allows only foot traffic now, but the bridge is designed to accommodate horse traffic if this use is considered desirable in the future.

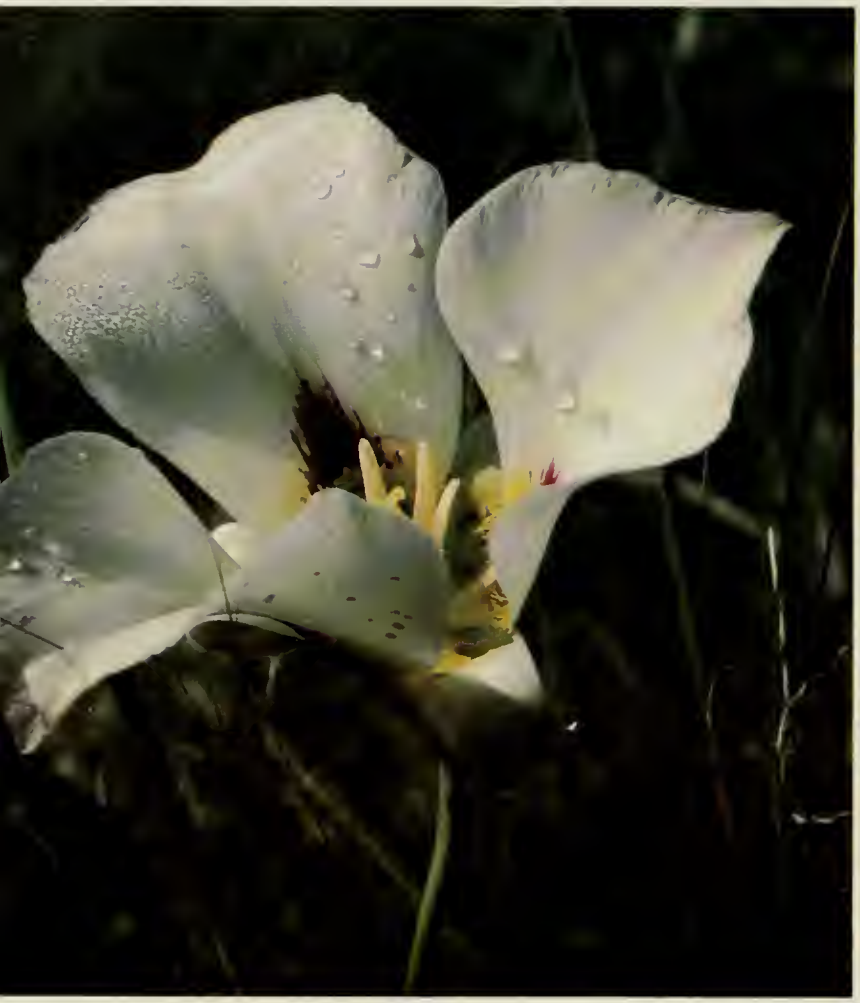
The bridge will provide easier access to approximately 5,000 acres of public land where access had previously been severely limited. It also enables visitors to walk to the east side of the river where the most spectacular views of the site are found. ■

above photo: Dean E. Biggins
right photo: Danny On

Guidepost To Spring

All those who love Nature she loves in return, and will richly reward, not perhaps with the good things as they are commonly called, but with the best things, of this world—not with money and titles, horses and carriages, but with bright and happy thoughts, contentment and peace of mind.

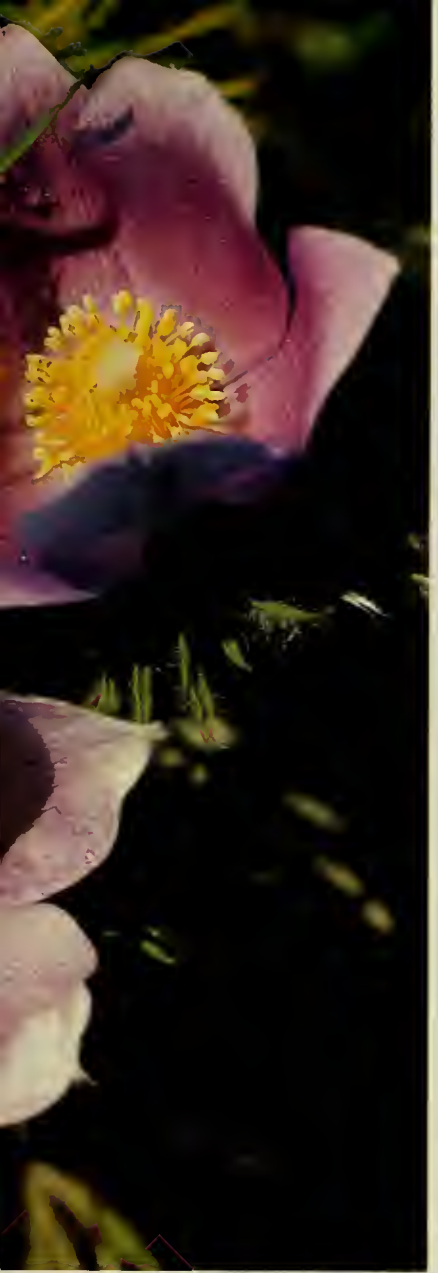
JOHN LUBBOCK



DFWP photo: Mike Aderhold

Take the flower that hangs in the morning, impearled with dew, arrayed as no queenly woman was ever arrayed with jewels. Once shaken, so that the beads roll off, and you may sprinkle water over it as carefully as you please, yet it can never be made again what it was when the dew fell silently upon it from heaven. . . .

HENRY WARD BEECHER



above photo: Larry Thompson
right photo: H. Peder Waldum

And why take ye thought for raiment?
Consider the lilies of the field, how
they grow; they toil not, neither do they
spin: And yet I say unto you,
That even Solomon in all his glory was not
arrayed like one of these.

MATTHEW 6:28-29

above photo: Thomas Maurer
right photo: Tony C. Caprio

You must not know too much, or be too precise
or scientific about birds and trees and flowers
and water-craft; a certain free margin, and even
vagueness—perhaps ignorance, credulity—
helps your enjoyment of these things.

WALT WHITMAN

above photo: Sue Thompson
left photo: Dean E. Biggins

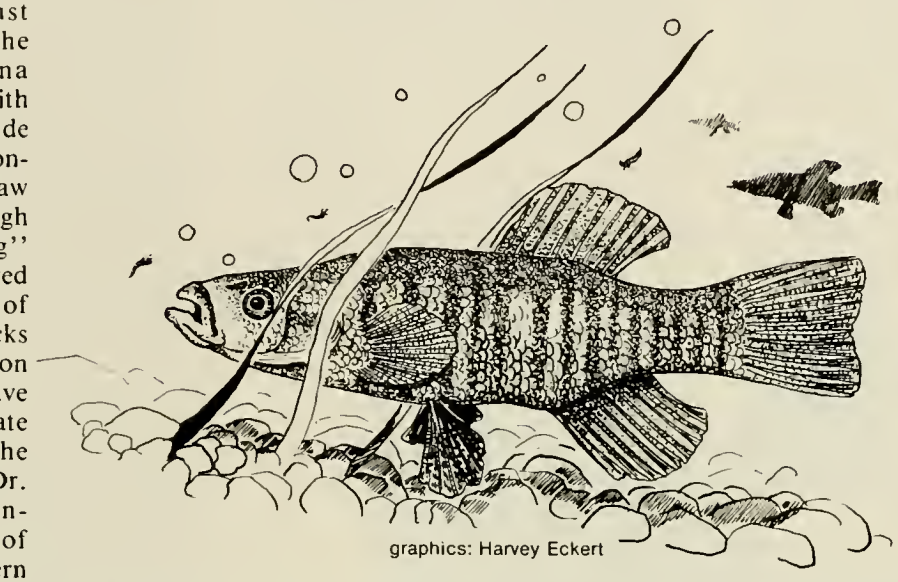
As long as I live, I'll hear waterfalls and birds and winds sing. I'll interpret the rocks, learn the language of flood, storm, and avalanche. I'll acquaint myself with the glaciers and wild gardens, and get as near the heart of the world as I can.

JOHN MUIR

photo: George Wuerthner

In Search of Native Killifish

by Al Elser



graphics: Harvey Eckert

IT WAS HOT—hot like only a scorching August afternoon on the eastern Montana prairie can be. With no shade to provide relief, I was convinced the old saw about "hot enough to fry an egg" would have proved true. As a matter of fact, the flat rocks lying along O'Fallon Creek would have made an adequate frying pan. The seine with which Dr. Norman Schoenthal, professor of biology at Eastern Montana College in Billings, and I had been sampling, is popularly called a "common sense" minnow seine. But two biologists out collecting fish in this blistering heat seemed a little short on sense, common or otherwise.

Our hauls had brought up the usual assemblage of prairie fishes—carp, goldeye, flathead chubs, redhorse suckers and various minnows. We decided to make just one more haul before seeking relief at our own kind of watering hole. Then there it was, in the middle of a squirming, wiggling mass of fish. It looked like other minnows, but the dusky bars on its silver sides told us otherwise. Suddenly the heat wasn't so stifling: We had collected a killifish.

The collection of a killifish wasn't anything so great; yet it was important because the killifish had previously been documented in Montana only in the Bighorn River drainage. Efforts to find it in similar habitats in other parts of the Yellowstone drainage had failed, probably because of the species' geographical shifts. Fish populations change—multiplying and spreading into new areas, dying out in other places, forming new geographical patterns. Ranges of fish are pulsating and dynamic and not the stationary dots we view on maps. Was the O'Fallon Creek killifish a recent immigrant or had killifish simply evaded past sampling attempts?

In "Fishes of Montana," Dr. C. J. D. Brown suggests the killifish is not native to Montana and probably entered the state in a downstream migration from the Wyoming section of the Bighorn. Wyoming fisheries experts suggest the killifish owes its presence in the Bighorn to introductions by bait fishermen. So the question remains: Are killifish native to Montana or are they, in fact, invaders? That was the question spawned that hot August afternoon on the banks of O'Fallon Creek.

These small fish belong to the family Cyprinodontidae—killifishes or topminnows—which dates to the Oligocene era 35-40 million years ago. Most members of this family inhabit shallow areas of fresh water; they are seldom found in water more than six inches deep. Others move freely into brackish and salt-water environments. They are distributed on all continents except Australia but are most abundant and diverse in tropical regions.

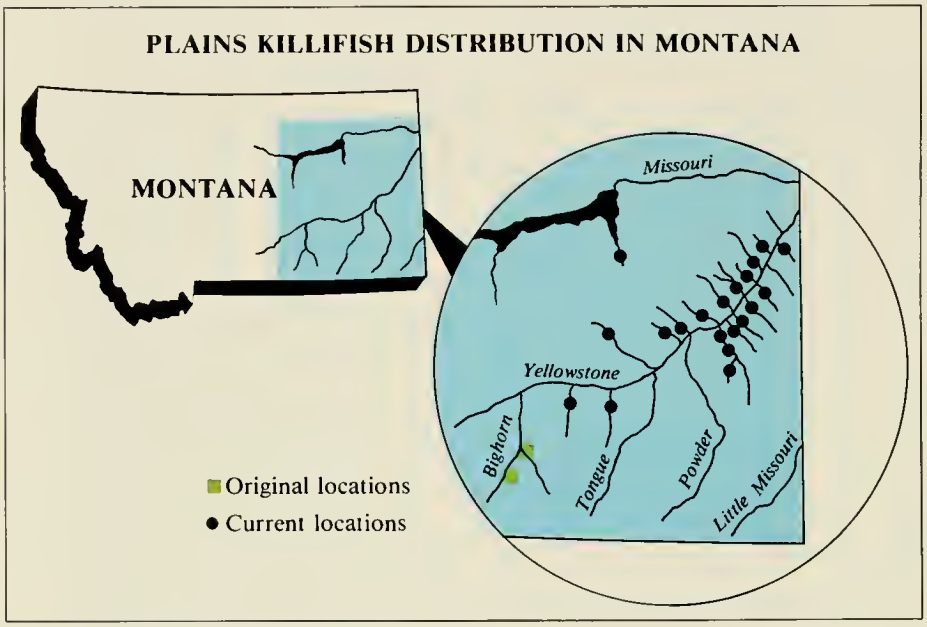
Killifish have many features that separate them from minnows and other small fishes that inhabit Montana waters. The most unusual characteristics are related to their way of life. For example, killifish are often called "topminnows" because they skim along just beneath the surface of the water, feeding on insects. Their broad, flat heads are covered with large platelike scales, with the mouth tilted upward so that it opens at the upper surface of the head. A deep groove separates the upper jaw from the snout, allowing a considerable extension of the jaws. These adaptations help killifish in feeding on surface insects. These fish are often called "cyprinodonts," which means "toothed carp," and refers to the many small teeth on the jaws. Basically cigar-shaped, the body lacks the lateral line (a row of scales with pores which occurs along each side of most fish). Coloration ranges from olive-brown on the back to yellowish and white on the sides and belly, with 12 or more narrow, dusky vertical bars on the sides. During the spawning season, the males' fins turn bright yellowish-orange and they develop small spine-like structures on scales and fin rays. These nuptial tubercles play an important part in killifish courtship behavior. During breeding, males

touch the females, providing a stimulus to release the sex materials in synchronization. This is the male killifish's way of telling the female, "Now is the time."

Despite their adaption for surface feeding, topminnows feed effectively at all levels. Their food habits are generalized and although they prefer aquatic insects, they also feed on plants. Killifish sometimes stir up the stream bottom with quick sideways darting movements and then search the suspended cloud of debris for food.

Throughout their range, killifish normally inhabit streams with alkaline or saline waters attractive to few other fish species. Biologists suggest that killifish distribution is limited because they require saline water or because they can't compete with more diverse fish populations. Where abundant, killifish populations expand to all types of habitats —from pools and backwaters to shallow, sandy areas with strong currents. They spend most of their time in loosely organized schools; during periods of inactivity, they often lie buried in the sand with only their heads exposed. Spawning follows moderate or heavy rains, which suggests that reproduction is stimulated by a sudden freshening of water.

Killifish have caused a stir in Montana since their first documentation. The first specimen taken from a drainage ditch tributary to the Little Bighorn River near Hardin in 1959 was identified as a banded killifish *(Fundulus diaphanus)*. Based on this information, Dr. Brown published a preliminary list of Montana fishes in the "Proceedings of the Montana Academy of Sciences" in 1962 and erroneously listed the banded killifish. Dr. Brown corrected the identification in 1968 to the plains killifish *(F. kansae)*. Increased sampling efforts during the mid-70s showed a greater distribution of plains killifish in the prairie streams of eastern Montana and they have since been documented in 19 streams in the Yellowstone Basin. Plains killifish populations in the headwaters of Yellowstone River tributaries have resulted in challenges to its non-native classification.



But if it is native to Montana, shouldn't it also be found in the Dakotas? A review of plains killifish distribution revealed they only inhabit the Missouri River drainage downstream from the Platte River drainage. In terms of the plains killifish in Montana, that leaves quite a geographic gap—from the Platte to the lower Yellowstone, covering half of Nebraska and all of South Dakota and North Dakota. The cloudiness cleared some when biologists found plains killifish in Nelson Creek (a tributary to the Big Dry Arm of Fort Peck Reservoir) and in the Little Missouri River in extreme southeastern Montana. The distance separating these two populations from those in the Yellowstone adds credibility to the argument for native status (see map).

There was one fleeting moment of resurgence when we tried to explain the killifish's presence in Montana by going back to Dr. Brown's initial identification of banded killifish. In "Freshwater Fishes of Canada," W. B. Scott and E. J. Crossman showed banded killifish widely distributed in southern Canada, in the Great Lakes Basin and "to the Yellowstone River in eastern Montana." So we collected additional fish from 13 of the streams inhabited by killifish. But the excitement waned as rapidly as the comet Kohoutek, as each population was positively identified as plains killifish. So, the true brilliance in decision-making reflected back to Dr. Brown's knowledge of Montana fishes.

Based on their widespread distribution, many fishery biologists now lean toward native status for plains killifish. But even if they are native, of what value are they? They have no sport or economic worth. Killifish are useful for mosquito control since they feed on mosquito larvae but probably not to the point where it does any real good. They are unusually hardy, reportedly staying alive packed in moist leaves in a tin can without water for many days—an attribute of good bait minnows. Yet most anglers consider them poor bait. They also provide some forage for stream-based predators.

But there's more to the story. One has only to recall the snail darter, that three-inch bit of obscurity that brought a $190-million-dollar dam project to its knees—at least temporarily—to realize that all cogs in our environmental wheel are important. The plains killifish is a part of the integrity of the lower Yellowstone River and as such it is important. It is as William Beebe, the noted naturalist, once wrote: "When the last individual of a race of living things breathes no more, another heaven and another earth must pass before such a one can be again." And therein lies the importance of the plains killifish—it is important because it is. ■

Montana Outdoors Makes a Great Gift For Dads & Grads

Readers Respond

Special Hunting Issue—A Classic

Your special issue of *Montana Outdoors* is a classic. Any one of the articles could have been written by any one of millions of hunters. All of the authors projected a common message, not by the words they used but by the feelings they conveyed.

I have hunted with many people, including relatives and friends. The bond between us has always become stronger because of a hunt. Hunting partners become a team that enjoys the pleasure of sharing experiences and the privilege of being a part of the natural scheme of nature.

I know many nonhunters are vehemently opposed to hunting. Much of this is because of slob hunters; i.e., hunters who are either careless, game hogs, violators or show no respect for property or the environment. We must come down hard on the "slob" if we are to protect the image of hunters and the future of hunting.

I am impressed with the teen-age hunters and I think hunting has been a positive influence for them. Why? Maybe because it allows them a special camaraderie with a parent, or simply because it gives them something to do. Most important, it teaches them to coexist with the natural scheme of things and take no more than they are willing to give.

Can we preserve our natural heritage for future generations? I hope so. Because of money from hunting licenses, special fees, taxes on ammunition and guns and the dedicated, continuous efforts of many people and organizations—made up of hunters and nonhunters alike—we may.

We must work together to assure success. We must realize a healthy environment for game animals is also good for nongame animals and people.

Thank you, Montana, for allowing all Americans to share your bounty. If we hang together, it will be as plentiful for our kids' kids' kids.—*John Mullen; Rockford, Ill.*

* * * * *

A fan letter herewith: I have just finished reading your Special Hunting Issue and want you to know how very fine it is. I—a true "tree-hugger," an animal lover rather myopic in my views—was impressed, mainly because the approach to and arguments for hunting were intelligent. The reasons were valid and the manner of presentation was sound. There wasn't any name-calling; there wasn't any ignorance in either the tone or the writing.

You took on one hell of a subject and sure did it well.—*Delphine Haley; Seattle, Wash.*

* * * * *

The Special Hunting Issue you just turned out is super. It is enjoyable to read through a nice publication like this one.

Of course, having a pro such as Charley Waterman included doesn't hurt anything. He's one of the best writers in the country.—*Dr. Sam Fadala; Casper, Wyo.*

* * * * *

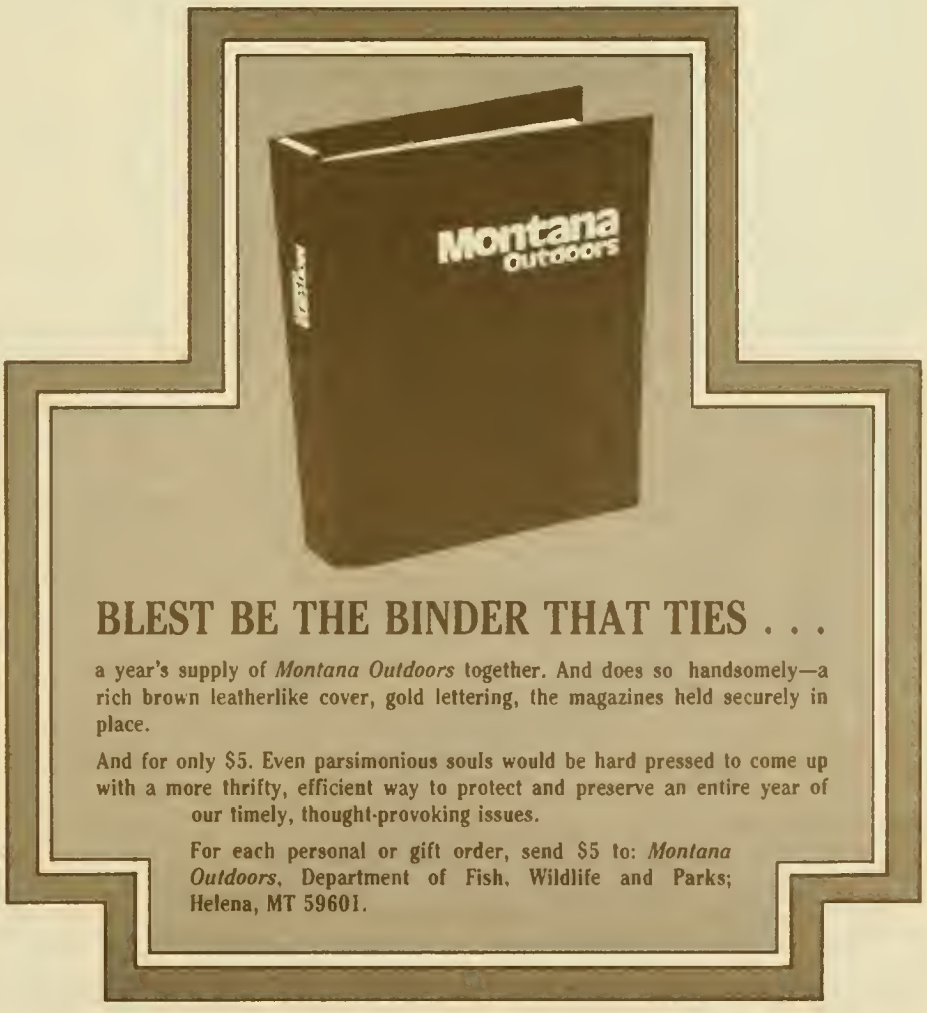
I very much enjoyed and approved of the Special Hunting Issue of *Montana Outdoors*, especially the good article by Jim Posewitz, "Deer Mountain and the Conservation Cause." So for fun, I wrote the following essay on why I liked to hunt:

Why I Was a Hunter

Now, I am a harvester. As Cicero said, "The harvest of old age is the abundance and recollections of blessings previously secured," and many of these blessings pertain to hunting.

Why? Why does a bird dog seek grouse; a Labrador, water, and a hound want to trail cats? I guess it was part of my heritage. Among my earliest recollections are the ducks and grouse my father brought home. And the Stevens Favorite .22 he gave me when I was about 10. And following him in the hills hunting ruffed and blue grouse, when I would generally get one or two.

It was the outdoor exercise in the clean woods—the focus on a definite objective,



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my ability to see and bag my game. It was a contest between me and the game.

Later, when I could go into the big mountains on pack trips, it was an adventure full of surprise and danger. We had to learn how to take care of ourselves, our horses and our camps. I scarcely remember a pack trip, whether fishing in summer or elk hunting in the fall, that we did not have incidents of high adventure and danger—by way of water, bad trails, lost horses or grizzly bears.

When one took his rifle and made his stalk and shot accurately and downed his bull elk and walked up to his kill, his primordial instincts swelled. He felt he was a man. That euphoria continued as he field dressed his bull, propped the rib cage open to cool, got sticks under the body to get the animal off the ground and then, wrapping the liver in his big bandanna handkerchief with some kidney fat (for boot grease), blazing his way down through the timber to the trail. How easy the trail to camp seemed, and the pleasure in nonchalantly showing his blood-encrusted hands and, as a finale, the soaking of the liver, the slicing and the frying with bacon and onions.

What if I didn't get my game (which often happened)? It was still a great success because of the nice camp, the hard hunting and often a lot of photography. It can happen that a trip is less than perfect because of a hunting partner one was not properly acquainted with.

If I want to think about hunting in the abstract, I know that it is the hunter's money that makes and preserves the wetlands, buys game ranges and fishing access spots and tries to inform the public of what hunters do to advance the cause of reasonable conservation.

Finally, hunters harvest a valuable food crop and, in many cases, hold the game population within the limits of range and food supply.

I am thankful that all of our fine competitive physical sports tend to develop and satisfy our deep biological instincts to hunt by recognizing the Lord's law of the survival of the fittest.

Let us remember, as Cecil Frances Alexander wrote, that:

"All things bright and beautiful,
All creatures great and small,
All things wise and wonderful,
The Lord God made them all."
—*Forrest C. Rockwood; Kalispell, Mont.*

* * * * *

I've just finished reading your special issue and I was quite impressed with the centerfold, entitled "On the Wing." I would like to compliment you and your staff on the fine publication you publish. I enjoy receiving this magazine and the informative materials you discuss make excellent reading.—*Calvin G. Scholl; Fargo, N.D.*

* * * * *

I just received my Special Hunting Issue of *Montana Outdoors*. Needless to say, this is the finest issue of any kind that I have ever seen on the sport of hunting. It will be saved by me and shown to all of my friends and relatives.

I am enclosing a check to cover the cost of three additional copies. Please rush them to me as soon as possible.—*Howard D. Sherer; Mason City, Iowa*

* * * * *

Congratulations on your Special Hunting Issue which I have just read. West Virginians feel the impact of the anti-hunter drive and resent it, too.

Your special issue gives a fine slant to the nonhunter, such as photographers, birders, etc.

I have been fortunate to have visited your state four times and been shown about much of the area near Alberton, Choteau and Glacier and Yellowstone National parks by a very competent guide, my son Gene Sentz of Choteau. I'd bet he has stood atop as many high points in the Rockies as anyone you can find.

He began to hunt at age 9. I'm still at it at 81, but mostly, now, in good weather for 'chucks—or "whistle-pigs" as we hillbillies call 'em.

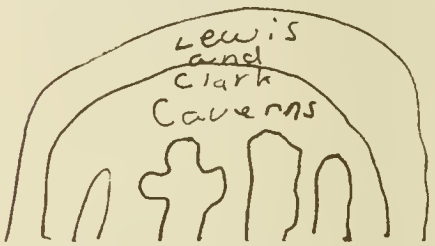
Thanks for the splendid work your magazine is doing.—*A. F. "Pete" Sentz; Hinton, W. Va.*

* * * * *

My check for $10 is enclosed; please send me as many copies of your Special Hunting Issue as this will buy.

I can't compliment you enough on the excellence of this issue. One article in particular—"Deer Mountain and the Conservation Cause" by Jim Posewitz—will explain hunting so much better than I've ever been able to do to my nonhunting (and some who are anti-hunting) friends and relatives. I hope to use the extra copies of this issue to let some of them understand for the first time.—*Norman C. Roettger, Jr., Judge, United States District Court, Southern District of Florida; Fort Lauderdale, Fla.*

Visit to the Caverns



I went to the Lewis and Clark Caverns last summer and wrote this about what it was like:

Lewis and Clark Caverns

I went to the caverns,
The caverns so high.
With sculptures and figures,
Like birds in the sky.—*Charlene Lewis age 10; Helena, Mont.*

Migrating?

If you're planning to move in the near future, please attach the label from your last issue and send it and your new address to *Montana Outdoors,* Department of Fish, Wildlife and Parks; Helena, MT 59601. Please allow six weeks for the change to appear on your magazine label.

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Docile Dinosaur
by David Quammen

ONE SPECIES of beast that dwells in Montana's free-flowing rivers is drastically unlike any other. It grows to be very old and very large, much older and larger than its cousins. It is clumsy and lumbering, in an environment where speed and agility are at a premium. It lacks almost every recognized physical adaptation for life in fast-moving water; yet it makes its home and does its business in the fastest, heaviest current. At its most vulnerable time of life, when it mates, it is slaughtered routinely and almost effortlessly by predators who glut themselves to the point of satiety—and that wholesale carnage is itself part of the creature's strategy for survival. It returns in equally vast numbers the following year, easy food for all comers, satisfying all, and survives again. This festival of death is known to humans of the fisherman subspecies as "the salmon fly hatch." Grown men eavesdrop in tackle shops to glean news of its onset. The summer vacations of New York stockbrokers are plotted to coincide with it. The animal is gentle, nonpredaceous, an equable vegetarian: *Pteronarcys californica*, the largest of the North American stoneflies.

Adult *Pteronarcys* are known as "salmon flies," because of the lambent orangish-pink coloring of their underbellies, a decorative exception among a generally drab order of insects. Adolescent *Pteronarcys*—the wingless, aquatic nymphs—are also referred to as "big curlers" (because their posture of defense resembles that of an armadillo) and sometimes as "hellgrammites" (incorrectly, since a genuine hellgrammite, which distinguishes itself with a bite like a snapping turtle's, is the immature form of a quite different insect, the dobsonfly, nonexistent in Montana rivers). Precise scientific usage would be "*P. californica*," or just "*californica*," since several other and less extravagant species of *Pteronarcys* exist. But what joy can come of calling Montana's most characteristic insect after a state full of people on disco skates? Don't californicate *californica*. Let *Pteronarcys* be taken to indicate, here at least, the big guy with the inappropriate last name.

Montanans aware of no other water-bred insect, except perhaps the mosquito, know of the salmon fly—especially if there is a fisherman in the family. But neither they, nor professional entomologists, know much about it. The

graphics: Harvey Eckert

natural history and biology of *Pteronarcys* is still, from the human point of view, a mixture of scattered facts, patchwork conjecture and broad ignorance. To my mind, it also includes one downright mystery.

First the facts. Eggs of the *Pteronarcys* are laid during late May and June, sometimes early July, in large sticky clusters that wash free of the female's abdomen as she dapples across the water's surface. The clusters break up, the eggs sink, and each glues itself individually to some rock or log on the river bed. The uniqueness of *Pteronarcys* biology begins right here: Eggs of most stonefly species hatch in two to 16 weeks, but *Pteronarcys* eggs rest on the bottom for 10 to 11 *months* before hatching. This odd delay probably involves a period of defensive dormancy known as "diapause," during which no development takes place, but the embryo *Pteronarcys*, protected within the egg, is much less vulnerable to destruction by drought or flood than if it were a young hatchling. If a climatic crisis intervenes and wipes out the yearling nymphs of all stonefly species, *Pteronarcys* will reappear, like Lazarus, the next summer. It is in no hurry to complete its life cycle. Evolution has evidently taught it that surviving—doing the job right—may require a little extra time.

The egg finally hatches to a wingless, six-legged nymph. The nymph lives for a full three years—half again longer than any other Montana stonefly, and three times as long as most—on the river bottom, eating, molting its successive skins and growing larger, much larger. On the threshold of puberty, a *Pteronarcys* nymph is roughly two inches long and weighs close to one-fourth ounce. With the elaborate plating on its midsection, it looks like a docile dinosaur in miniature. Incapable of swimming, it clambers across the boulders beneath heavy riffles with all the grace of a beached alligator. It continues to graze peacefully on algae and leaf debris, stocking reserves of fat into its long, cylindrical abdomen. Then, some time in May or June of its fourth year, signaled by rising water temperatures and lengthening days, it begins its trek toward shore and the lethal responsibilities of adulthood.

When the water temperature goes above 60°F and holds at that level for something between two and seven days, the emergence of adult *Pteronarcys* begins. The nymph crawls out of the water onto a rock or up a willow branch, a climactic telegraphy of hormones flowing within its body; it splits down a seam along its back; and an adult salmon fly steps out of the old skin. Like the emergence of a Polyphemus moth from its cocoon, this is a quietly magical spectacle.

When its wings have dried stiff, the adult flies off to find love and other sorts of trouble. A terribly inept flier, it is barely airworthy, thrashing large wings with small muscles to keep its great drooping body aloft. Males and females find each other in the nearby trees, and once they have mated—which they are not so foolhardy as to do in midair—the

females fly on again, always upstream, to drop their eggs on the water and die, or be eaten, or both. Birds and trout take full advantage of the moment; fishermen, profiting from the trout's uncharacteristically reckless gluttony, are also in close attendance. The cycle repeats.

So: An animal that cannot swim, can barely fly, lacks the mouth parts and other weaponry for carnivorous predation, is not at all flattened in body shape to deflect current force like most stoneflies and many mayflies, has no ballast to anchor and protect it like the case-building caddisflies and offers itself in an extravagant summer banquet to its natural enemies, this animal lives to a venerable old age, grows large and fat, and prospers numerically in the most relentlessly challenging of habitats. How? Why?

No one quite knows.

Many fishermen would say that *Pteronarcys* exists as it does because God, in His goodness, wants trout to attain high rates of growth. In the ecology of trout in such cool, fast rivers as the Madison, *Pteronarcys* does in fact occupy much the same esteemed position that the buffalo once occupied in the ecology of the Plains Indians. *Pteronarcys*, grazing on algae and scraps of dead leaves, bypasses several stages in the chain of predation and functions, like the buffalo, as an extremely efficient organic machine for converting vegetable matter into fat and protein. Yet evolutionary survival is a selfish game, and no species ever endured simply because it was a boon to some other.

Professional entomologists have their own answers, mainly conjectural. Each answer leaves place for a further question, and at the end is a last question, unanswered. Why does *Pteronarcys* drag its large, oafish body about in the heaviest water of the fastest riffles? Because otherwise it will suffocate. In order to respire, it requires high concentrations of dissolved oxygen in the water around it, and that necessitates living life in the fast lane, where oxygen is constantly stirred in. Why is it not flattened, supplied with a sucker, a friction pad, a pair of hooks, a pebble case, a set of silk glands for weaving itself a net, like almost any other insect that makes a life in the heavy current? Well, it *is* shaped to some advantage for avoiding the current's force, but not in a manner common to insects. It is instead "fusiform,"—hydrodynamically streamlined, round in cross section and tapering, with its widest point roughly 36% back from the head—like a trout. Why does it fly so poorly? Because it requires a river to fulfill its life cycle, and rivers obviously occur only in certain spots. Any *Pteronarcys* female with the exceptional wing power to fly off from the Big Hole and make her way to a meadow high in the Pintlars will leave no offspring to be proud of her achievement. Why does a whole population of *Pteronarcys* emerge to adulthood almost simultaneously, in a great cloud of helpless flying meat? For the same reason that 50 soldiers do not storm a machine gun nest one by one. When all predators have been temporarily sated, the remaining *Pteronarcys*, no matter how pathetically vulnerable, escape and successfully procreate.

Why does it live so much longer than other insects? The entomologists don't say, don't yet know. The total life span of most insects, both aquatic and terrestrial, varies between six weeks and a year. A few species live longer. *Pteronarcys* lives to be four. Why? Part of the reason must be so that it can grow to its relatively immense size.

Why does it grow so large? Some entomologists guess that this size, which makes it so tempting to trout, frees it at the same time from predation by other insects and results in a net advantage. But the logic does not seem to hold, because *Pteronarcys* is roughly the same size when it comes out of the egg as most other aquatic insects and does not grow appreciably faster. So the *Pteronarcys* nymph spends about the same amount of time as a small vulnerable morsel that other species do. Then it perseveres at its growing, to become a large vulnerable morsel for predators of a new order of magnitude.

Why does it grow so large? Because it lives a long time? No, that explanation is circular, and therefore meaningless. Why then?

There is a reason, an evolutionary angle. There has to be. But I don't know it and I don't know who does. And I suppose that's why I enjoy thinking about the marvelous little beast. ■

Wildlife Shorts

The eyes of a hippopotamus protrude so far and are situated so near the top of its head that it can lie almost completely submerged in muddy river shallows and still keep a sharp lookout.

* * * * *

An average of about two calories of radiant energy from the sun falls on each square centimeter of the earth's surface each minute of each day.

* * * * *

For every 400 feet of altitude, the growing season is shortened by about four days at each end of the season.

* * * * *

Kingfishers and terns dive headlong from air into water.

* * * * *

The tail of mammals comes in diverse forms and serves in different ways—in hoofed animals, it may serve as a fly swatter, while other animals may use it for support and balance. Certain water mammals, such as whales, beaver and muskrat, use their tails as rudders. Opossums and some monkeys have a prehensile tail (one used for grasping).

* * * * *

The number of eggs produced by each female depends on the average chance for survival to maturity of any one offspring. If hazards are great, the number of eggs produced is large. A brook trout produces up to 5,600 eggs; a quail averages 14, and a robin, three to five.

* * * * *

Ancient medical writers mention uses of earthworms in treating humans. Some of these methods are still used in parts of Japan and China.

* * * * *

The tail feathers of woodpeckers are especially adapted for climbing and food gathering because of their pointed tips and considerable rigidity.

* * * * *

Jack rabbits are born fully haired and with their eyes open; they can move about within minutes after birth.

* * * * *

Man and primates have the greatest development of facial muscles in the animal kingdom. A few carnivores, such as the cat, may indicate pleasure and anger, but in all vertebrates below the mammals on the evolutionary scale, the face is a rigid mask.

* * * * *

The first use of wild animals for man's benefit was about 7,500 B.C. Members of the Canidae family (dogs, wolves, foxes) were the first to be domesticated.—*Vince Yannone, youth educator, Conservation Education Division*

DFWP photo: Mike Aderhold

WILDLIFE AND ENERGY DEVELOPMENT: MONTANA'S FUTURE OPTIONS

Montana is nationally known for its vast fish and wildlife resources and also for its tremendous energy reserves. The potential for conflict between fish and wildlife values and large-scale energy development is not difficult to imagine. In the final analysis, it boils down to one word: *habitat*. The water that cools a power plant may have once covered sauger spawning grounds in the lower Yellowstone. Sagebrush-covered knolls and brush-filled draws, some of the finest cover for sharp-tailed grouse and mule deer in the West, become merely overburden for the dragline anxious to reach the coal beneath.

Given the national panic for discovery, extraction and exploitation of new energy resources, the potential for rapid and uncontrolled energy development exists for Montana and other western states. The fish and wildlife resources of our state, the people who currently enjoy and benefit from them and the unborn generations who should have the opportunity to enjoy them stand to lose the most from rapid development of these energy reserves. This article traces the evolution of energy problems, analyzes the impacts of meeting energy demands by increasing domestic supplies and offers alternatives designed to minimize energy impacts to Montana's fish and wildlife heritage in a way least likely to fan the fire of inflation.

continued

by Ken Knudson and Larry Peterman

First, let us present a bit of information on why the nation has what appears to be a sudden and intense need to expand energy development. In the 1950s and '60s, oil was cheap. Protected from what was then nearly unwanted foreign oil, domestic oil production continued to climb. The formation of the Organization of Petroleum Exporting Countries (OPEC) in 1960 was almost a "nonevent" since these oil exporting nations could do little to effectively influence the world market. However, the burgeoning energy appetite of the United States soon changed this picture:

> The historic turning point came in 1970, when U.S. spare capacity vanished and U.S. production reached what proved to be its peak—an average of 11.3 million barrels a day. From then on, the level of oil production began to decline. But as demand continued to increase, cheap imported oil took a larger and larger share of the U.S. market as ever-larger cracks began to appear in the oil import barrier. In response to sporadic shortages that began to develop around the country, the Nixon Administration abandoned import quotas in 1973, and imported oil poured in.[1]

The subsequent Arab oil embargo demonstrated that we had drifted into a new and frightening age of energy dependency. With startling abruptness, citizens were informed that 30% of their daily consumption of petroleum products came from abroad—much of it from politically and socially unstable countries. Acronyms like "OPEC" became household phrases and the media became clogged with references to "energy crises," "gas lines," "fuel allocations" and "Project Independence."

The Arab oil embargo marked the first time since World War II, some 30 years before, that fuel was not readily available in seemingly unlimited supply. It also underscored with stark clarity our reliance on wavering lines of oil tankers from abroad. This alone should have jolted us into reality, but it did not. After the embargo was lifted, there was a seeming overabundance or "glut" of oil on the world market, and our country, for the most part, slipped back into complacency toward our energy problems. The supply outlook improved and prices, which had briefly skyrocketed, stabilized. Fuel was available and moderately priced. The economy recovered from a mild recession and sales of big cars and other gas-guzzling vehicles once again surged.

To be sure, a few voices could be heard extolling conservation, warning of the dangers of dependence on foreign oil, talking in terms of "handwriting on the wall." But the voices were few and not nearly loud enough to be heard over the roar of engines in a variety of essential, nonessential and frivolous pursuits. Five years later, the government in Iran was overthrown, hostages were taken and 5%-10% of our daily ration of fuel was curtailed. This time, however, instead of being somewhat less than 30% dependent on foreign crude, we were almost 50% dependent. Gasoline lines reappeared, prices skyrocketed and fuel again was in short supply. The handwriting on the wall is much clearer now.

How, you may ask yourself, did we get into such an unbalanced energy supply/demand situation?

- In the 1960s and early '70s, total energy consumption via the conventional sources of oil, electricity, natural gas and coal grew at a rate of nearly 5%-6% per year, which equates to a doubling of energy demand in slightly over 10 years.[2]
- In 1960, the United States consumed slightly less than 10 million gallons per day (mgd) of oil; less than 20% was imported. By 1980, consumption had risen to nearly 20 mgd, with nearly 50% supplied by foreign sources.[3] Both consumption and dependence on foreign oil have doubled in two decades.
- In 1960, there were approximately 90 million private automobiles in the United States. By 1975, there were nearly 215 million—a whopping increase of nearly 140%.[4] Cars rapidly began to replace energy-efficient transportation forms such as railroads and buses. Suburban sprawl continued, increasing the need for additional cars.
- During the past two decades, the U.S. population has increased from approximately 180 million to 220 million.[5]

The statistics reveal that disproportionate energy growth is occurring, since in the past 20 years the population of the United States has increased by only one-fifth while energy-related growth has more than doubled!

Other energy sources have followed a pattern of accelerating growth *and* cost similar to oil. Take electric rates for example. In the Northwest, we have become accustomed to relatively low utility bills because much of our power has been supplied by facilities built before 1970. Other areas of the nation where new nuclear and steam electric facilities have recently come on-line are not so fortunate. For example, as of July 1, 1979, Consolidated Edison customers in New York paid a base rate of $28.04 per kilowatt hour (kwh) of electricity for up to 250 kwh, while Montana Power Co. customers paid $8.40.[6]

Another example illustrates that Montanans are not immune to the rising costs of new energy facilities. Compare the costs of three Montana coal-fired generating plants that have gone on-line during the past 15 years:[7]

Plant name	Rated capacity (mw)	Total construction cost (million $)
Corette	180	22
Colstrip 1 & 2	660	295
Colstrip 3 & 4	1,420	1,400 (est.)

The above figures show that costs of building power facilities in Montana have increased by leaps and bounds during the past 15 years. Although some may argue that pollution control requirements have been instrumental in these cost increases, the fact remains that measures to control air and water pollution—which if left uncontrolled would have substantial social and health costs—seldom exceed 5% of the total construction cost of a power facility. The cost per kw for just constructing coal-fired plants has increased by 750%—a figure many times above the overall inflation rate. Similar examples for other types of energy facilities could also be cited.

Indeed, the national energy supply problem is critical—not only in terms

of meeting present needs, but also long-term availability and cost stability. With the western states containing much of the nation's energy reserves, this region is looked to for the bulk of the increase in domestic energy production. A dramatic increase in the domestic supply portion of the energy equation will have severe social and environmental impacts where that energy is extracted, produced and refined. While the nation looks eagerly and expectantly on the West as a savior, the West looks back with apprehension and concern.

Montana is one of those western states containing potential reserves of gas and oil in the Overthrust Belt; an abundance of free-flowing, high gradient rivers; uranium potential just beginning to be realized, and at least 43 billion economically strippable tons of our national energy "ace-in-the-hole": coal.[8] Montana, and those concerned with her natural resources, have reason to look apprehensively toward the future.

The list of possible impacts to fish and wildlife from unfettered energy development in Montana is long and tedious. To put the various solutions to the energy crunch in proper perspective, the effects on air, land and water from various kinds of energy development must be addressed.

Completion date	Construction cost per kw
1968	$122
1976	$447
1983 (est.)	$921 (est.)

The major energy resources likely to be developed in Montana are coal, hydropower, gas, oil and uranium. While a modest degree of development of any one of these energy sources could probably be accommodated with minimal environmental disruption, the degree of development needed to make a significant contribution to our domestic energy shortfall would inflict significant and permanent damage to our state's fish and wildlife habitat. Development of coal and hydropower resources is likely to produce the most severe and long-term impacts, with gas and oil development running close behind. Let's examine each energy source.

COAL

The southeastern portion of Montana, northeastern Wyoming and western North Dakota contain the Fort Union coal formation. In Montana, scattered coal deposits can be found in other locations. Coal has been promoted as the major interim fuel source, a possible way out of the energy crisis and one of the most important energy reserves. In any national energy policy, coal is likely to play a key role. The development of Montana's coal reserves can take two forms: First, and currently most common, Montana coal is mined and exported to power plants outside the state. Or, Montana coal could be mined and converted to various forms of energy within the state.

The adverse environmental impacts associated with strip mining and transportation of coal have been well documented. The physical disruption to wildlife habitat during the mining operation; impacts associated with haul roads, railroad spur lines, vehicular traffic and dust; ground water table disruption and surface runoff; new communities, and problems with adequate reclamation have been discussed in many other articles. Significantly accelerating coal mining, whether for export or on-site conversion, would increase the occurrence of those impacts. With each new mine, the wildlife resource in the affected area would be compromised.

The on-site conversion of coal to more usable forms of energy also looms prominently on the Montana horizon. In the past, the principal coal conversion facility considered was the coal-fired electric generating plant. Now, however, the prospect of coal gasification or the production of pipeline quality gas and synthetic fuel ("synfuel") appear as real possibilities in the energy production arena. Fish and wildlife impacts from such on-site conversion facilities have far more widespread implications than simply the mining of coal. Generally, the more complex the energy facility becomes, the greater and more diverse the impacts on fish and wildlife.

The greatest impact is likely to come from synthetic fuel plants. From what little we know of them, synthetic fuel plants cover significant quantities of ground; a 60,000-barrel-per-day plant requires up to four square miles of land, if the plant currently operating in South Africa is any indication. In addition, a large companion power plant is necessary to provide energy for the synfuel plant and a separate coal mine is needed to supply the coal. Branching out from the plant boundaries itself, stack emissions from the power plant and the synfuel facility would adversely affect habitat and vegetation in downwind areas. The copious quantities of water necessary to cool the generating plant and to process the coal into gasoline would come from nearby water sources. In semiarid southeastern Montana, additional water diversions during critically dry periods would have significant adverse impacts reaching far beyond the fish and wildlife resource. Severe competition for an already limited water resource would be ensured. Existing water users would have a "new kid on the block" to deal with when drought years rolled around. Aquatic impacts, particularly on the smaller tributary streams of the Yellowstone, could be severe.

HYDROPOWER

The development of additional hydroelectric power on the state's waterways is a very real threat.

Montana is blessed with an abundance of rivers—some are free-flowing, and many still have a good portion of their length unimpounded. Since most have their headwaters in Montana, the gradients are relatively high. The combination of flowing water and high gradient makes most of the rivers inescapably appealing for impoundment (damming) and hydroelectric power generation.

Make no mistake about it—Montana's rivers are being seriously considered for additional hydropower facilities. While biologists commonly analyze river resources in terms of fishermen days of use, pounds of brown trout per 1,000 feet of stream or number of floaters per day, the U.S. Army Corps of Engineers (in a July 1979 inventory of the state's hydropower potential) refers to rivers in terms of megawatts of electricity, hydropower potential and power peaking capabilities. That particular

study reidentified such controversial dam sites as Allenspur on the Yellowstone, Reichle on the Big Hole, Spruce Park and Glacier View on the North Fork of the Flathead, five on the Big Blackfoot and many, many more.

Increasing hydropower production in Montana can take one of three forms, or a combination: (1) constructing new dams, (2) converting existing facilities from baseload to power peaking generation or (3) adding hydropower to existing dams. The impact from any one of these methods depends on the magnitude and location of the project.

Basically, construction of new dams on free-flowing reaches of river tends to devastate the river ecosystem. The reservoir floods the existing river, bottomland wildlife habitat and the prime agricultural land beneath it. In addition, impounding waters behind dams generally alters the natural flow regime downstream from the dam. Sediment trapped behind the dam alters hydrologic characteristics downstream and, depending on the outlet structure, the water released from the dam may affect downstream water temperatures. Examples of new dam projects proposed for Montana rivers include the Northern Lights' hydroelectric project at Kootenai Falls and the Water and Power Resources Service's (formerly the Bureau of Reclamation) proposed dam on the Missouri River at or above Fort Benton.

The second type of hydropower project which can impact aquatic resources is the conversion of a baseload generating dam to power peaking. Baseload generation is the daily, steady or constant generation of electricity; it requires a steady release of water from the dam. The fish and aquatic insect populations below baseload hydropower dams adapt to the steady release and the quality of the recreational fishery remains basically unchanged. Power peaking, on the other hand, is the generation of large quantities of electricity during peak load hours. A power peaking facility may generate large quantities of electricity for eight hours a day and be completely shut off for 16 hours. This means the dam would release large quantities of water for a limited period during the day but would be shut off for the remainder.

The impacts of power peaking on downstream areas can vary considerably, but they can have disastrous effects on fish reproduction in downstream areas. In general, fish move upstream during the spawning season to locate suitable spawning sites. When upstream movement is blocked by a dam, spawning often will occur just downstream from the dam. Successful trout reproduction depends on a steady flow of water over the incubating eggs. The "off" period when the facility is not generating electricity or releasing water would eliminate flow over the eggs and result in considerable, if not total, reproductive failure. In addition, the food chain could be impacted because aquatic insect communities immediately downstream also depend on flowing water.

Another major effect of power peaking is fluctuating water levels below the dam. If there is a reservoir immediately below a power peaking facility, water levels within that downstream or reregulation reservoir will be raised and lowered. Depending on the characteristics of the reregulation reservoir, the impacts may be minimal or severe. If, on the other hand, a free-flowing river exists below a power peaking facility, the downstream impacts can be disastrous. It is conceivable that the river immediately downstream would go from almost full channel flow to dry streambed in normal, daily operation. Effects on fish, wildlife and recreation under such an operating regime are obvious. When a power dam is converted from baseload generation to power peaking, there is often *little or no net gain* in electricity produced on an annual basis.

Perhaps the least damaging way of

If constructed, controversial dams, such as Allenspur on the Yellowstone River near Paradise Valley (left), could devastate the river ecosystem and flood bottomland wildlife habitat (DFWP photo: Mike Aderhold). Strip mining in Montana (below) poses a physical disruption to wildlife habitat during the mining operation (photo: Dick Juntunen).

increasing total hydropower output is to add generation facilities at existing dams. Many dams in the state were built solely for flood control and irrigation: the Tongue River, Clark Canyon, Tiber and Gibson dams, for example. To add generators without changing the release patterns achieves the goal of increasing net hydropower production while at the same time not harming aquatic resources downstream. From a fish, wildlife and recreation standpoint, this is certainly the most desirable option.

OIL AND GAS

The exploration for and development of oil and gas reserves in Montana is proceeding at a feverish pace. In the past, much of this activity was carried out on the plains and in foothill areas. In such terrain, it was possible (although not always accomplished) to carry out exploration work with minimal adverse environmental effects.

Spurred on by the energy crisis, the present trend is to explore deeper and deeper into the mountain areas of the state. The Rocky Mountain Front in Montana is an area of extraordinarily high fish, wildlife and wilderness values. The Sun River Wildlife Management Area, the Bob Marshall and the Gates of the Mountains Wilderness areas and many other areas are typical of the resource amenities prevalent along the east slope of the Montana Rockies. These same areas are considered crucial by the gas and oil industry.

Unlike earlier exploration in the plains and foothill areas, intrusions into mountain canyons, plateaus and hillsides cannot be done casually or unobtrusively. Roads must be built, equipment transported and testing accomplished. Much of this may happen in habitats critical to fish and wildlife and of high wilderness value. In the event that significant reserves of gas and oil are discovered in the mountainous areas, development of such reserves will not only compound the exploration impacts but introduce a new range of impacts associated with drilling, pumping, storage and transportation activities. Man will leave his mark on fish and wildlife habitat.

What we have presented so far is a rather gloomy picture. Americans have become accustomed to relatively cheap energy sources, but as resources (particularly oil) become more scarce, prices start to get out of hand. Projects are then proposed—mainly within "resource rich" states like Montana—intended to make our nation more energy independent. Unfortunately, they may fan the fire of rising prices and increase the potential for severe degradation of our fish and wildlife resources. Is there any hope for breaking this vicious circle?

First of all, some of the aforementioned energy projects probably should proceed. Montana has helped, and will continue to help, meet our nation's energy needs. However, each of the proposed energy projects must be examined very carefully to ensure that the investment of money and energy is recoverable and will in fact contribute to the solution to our present energy dilemma. The Libby regulating dam is a case in point. As Congressman Pat Williams (D-Mont.)

pointed out during debate about the project, if taxpayer dollars were to be invested in energy conservation programs rather than in the "rereg" dam development, many more positive gains would be made toward ultimately chipping away at our nation's energy deficit.

This type of logic—spending dollars where they will do the most good—is a welcome alternative to widespread resource exploitation, since it is in the best interests of our environment *and* pocketbooks. Conservation is the key word to this approach and it certainly is a term that is well known to nearly every American, particularly since recent events in the Middle East. But too much lip service and not enough positive incentives have been directed toward utilizing what is actually a largely untapped energy resource: "conservation energy."

"Conservation energy" is a term used repeatedly by Robert Stobaugh and Daniel Yergin, co-editors of "Energy Future," a book that summarizes six years of research by the Harvard Business School into various alternatives for coping with America's future energy needs. They conclude:

> If the United States were to make a serious commitment to conservation, it might well consume 30 to 40 percent less energy than it now does, and still enjoy the same or an even higher standard of living. That saving would not hinge on a major technological breakthrough, and it would require only modest adjustments in the way people live. Moreover, the cost of conservation energy is very competitive with other energy sources. The possible energy savings would be the equivalent of the elimination of all imported oil—and then some.

How can all of this come about? The authors further state:

> To many people, energy conservation means only curtailment or overhaul—something repressive and most un-American, involving cutting back, rationing and unemployment. They see it as the product of an anti-growth crusade led by the granola-chomping children of the affluent. Unhappily, some of the language of the Carter Administration—such as the President's insistence on "sacrifice"—has strengthened this unpleasant and misleading imagery in the mind of the public. But there is a third way to think about conservation: as a form of *adjustment*, entailing such things as insulating the house; making automobiles, industrial processes and home appliances more efficient, and capturing waste heat. This can be called *productive conservation*, which encourages changes in capital stock and daily behavior that promote energy savings in a manner that is economically and socially nondisruptive. Its aim is to use less energy than has been the habit to accomplish some task—whether it be to heat a home or to make a widget—in order to prevent disruption later. Conservation, therefore, is not a theological or ideological issue. It should be pursued not as an end in itself, but as a means toward greater social and economic welfare, as a way to promote the well-being of the citizenry (emphasis added).

"Productive conservation" therefore appears to provide the greatest hope for combating our immediate and long-range energy problems. The beauty of this approach is that it is the least environmentally damaging *and* the least costly solution. Positive gains in conserving energy can best be accomplished if positive incentives are made available to those who conserve. In 1979, Montanans *voluntarily* reduced their energy consumption by 5%-10% of the previous year's rate. This is encouraging and a credit to the people of our state, but reductions closer to the 30%-40% level mentioned above are achievable if proper rewards are made available to private citizens, cities, industries and other entities working to reduce their energy demand. Tax breaks and low interest loans for weatherizing and for alternative energy technologies such as solar and wind are presently available, but only to a limited degree. Also, no direct monetary rewards have been made available to citizens or groups that have reduced their consumption of gasoline, electricity, natural gas or heating oil. If such incentives were available, we could:

1. Substantially reduce the need for massive energy development projects with their concurrent potential to substantially impact Montana's fish and wildlife resources.
2. Place rewards for conservation in the hands of those who work hardest to reduce our energy deficit.
3. In total, spend less tax dollars by reducing energy demand than by attempting to increase energy supply.

What specific approaches need to be taken to best utilize productive conservation, our most substantial and largely untapped energy source? It is in the best interests of the fish and wildlife resources of Montana to fully explore these alternatives.

PUBLIC TRANSPORTATION

As mentioned earlier, automobiles and trucks have become the dominant form of transportation in the United States, essentially replacing railroad and bus systems. In 1950, 10 railroad systems operated in Montana; today, of the three that are left, one is bankrupt and one has substantially curtailed its service. Obviously, we must reverse this trend and begin moving people and goods in the most energy-efficient manner possible. We should start by rapidly developing mass transit systems both in cities and between cities. Fifteen years ago, it was possible to catch a train to many towns in the state. Today, we have only one AMTRAK route with no connector lines. Bus service has not picked up the slack, leaving people at the mercy of automobiles. City bus lines are also lagging in development or degenerating—have you ever tried to catch a bus in Bozeman? Helena? Miles City? Great Falls? Low interest or no interest loans should be made available to vastly upgrade, augment or initiate public transportation.

Another approach would be to require stricter fuel efficiency standards for automobiles. In 1974, the average fuel efficiency rating for automobiles produced in this country was a mere

12.8 miles per gallon (mpg). The Energy Policy and Conservation Act of 1975 set a goal of 27.5 mpg for the "fleet average" of all cars produced in the United States by 1985. This is encouraging, but other productive conservation measures should also be instigated.

A graduated tax based on horsepower or weight rather than on market value of vehicles could be enacted. A vehicle weight tax has for years been successful in states like Texas.

Procedures for providing direct rewards for mileage reduction in personal vehicles should be explored. For example, persons (or families) who achieved substantial reductions below, say, the 1979 average per capita mileage standards, would receive direct tax breaks or other positive incentives for their efforts.

PRIVATE HOMES AND COMMERCIAL BUILDINGS

Nearly 40% of all energy consumption in the United States is used to heat, cool, light and provide hot water for homes, factories and commercial buildings. During the past two decades of cheap power, most buildings were not built with energy savings in mind. For example, New York City office buildings put up between 1945 and 1950 used half as much energy per square foot as those built between 1960 and 1965; the same trend was evident in private home construction.[9]

Tax credits and low interest loans are now available on a limited scale for people to weatherize "older" homes and/or install alternative energy sources. These types of incentives also need to be dramatically increased. Rather than the 15%-20% tax credit presently available, national energy savings (and subsequent buying power gains for homeowners and businesses) could be dramatically increased by providing tax credits of up to 60% of installation cost for these energy conservation efforts.

As an alternative approach, a direct rebate for reductions in household power consumption should also be investigated.

INDUSTRIAL MANUFACTURING

Certain segments of the manufacturing industry have recently made great strides in reducing energy consumption. Between 1972 and 1977, Exxon reduced energy consumption by 21%, while some of Dow Chemical's plants reduced their energy needs by nearly 40%.[10] Most of these reductions were achieved by "good housekeeping"—better insulating, turning off equipment when not needed, reducing lighting, lowering settings on hot water heaters and keeping buildings at a comfortable, but not extravagant, temperature—in short, by using techniques that can be utilized in your own household. Tax incentives for such energy conservation measures should, of course, be made available to industries as well as to the private sector.

One other aspect of conservation energy should definitely be encouraged in industrial situations, that of utilizing the heated water produced as a by-product during industrial processes for space heating and/or electrical generation. Rather than discharging this heated waste water into rivers and streams, often after spending an enormous amount of money and energy to cool the water, this wasted heat could be used as an energy source. This process is called "cogeneration," and it supplied 15% of our nation's entire electric supply in 1950. Today, again largely due to the golden era of petroleum, it accounts for only 5%, opposed to 27% in other industrialized nations like West Germany.[11] We can think of no better place within the manufacturing sector to invest tax incentives than to revitalize this largely untapped energy source, since it would substantially eliminate the pollution caused by heated water discharges, while reducing the demand for new energy development projects.

Certainly, the Billings refineries, the large paper mill near Missoula and many of our state's large lumber mills and smelters are logical "cogeneration" sites.

What we have presented above is an outline of potential energy developments that could occur within Montana in the near future. However, before development proceeds, we hope that all of the cards are on the table and that conservation energy, a method of reducing energy demand, is given a fair shake when competing against projects oriented only toward increasing supply.

To continue on the development path of the past two decades will not be productive, for the consumer's pocketbook or for Montana's fish and wildlife resource. The term "conservation" has historically been related to conserving fish and wildlife. In the past, bag limits and seasons have been implemented to conserve our wildlife resources. It is apparent, however, that conservation of our other resources will ultimately aid in the conservation of our wildlife resource base. Without moderation in our energy consumption habits, the aquatic and wildlife habitat base will surely be eroded to meet our demands.

A conservation ethic must be rapidly developed by citizens and political leaders as well. This ethic, as well as alternative energy options, should be rapidly fostered as options to conventional energy development schemes.

LITERATURE CITED

[1]Stobaugh, Robert and Yergin, Daniel, "Energy Future," Random House, 1979, 353 pages.

[2]Meadows, Donella; Meadows, Dennis; Randers, Jorgen, and Behrens III, William W., "The Limits to Growth," Universe Books, 1972, 205 pages.

[3]Stobaugh, *op. cit.*

[4]Lovins, Amory B., "Soft Energy Paths—Toward a Durable Peace," Ballinger Publishing Co., 1977, 231 pages.

[5]"The World Almanac & Book of Facts 1980," Newspaper Enterprise Assn., 1979, 976 pages.

[6]Rogers, Paul and Pozza, Gordon, "Residential Electric Bills, Summer of 1979," National Assn. of Regulatory Utility Commissioners, 1980.

[7]Personal communication, Montana Public Service Commission; Jan. 30, 1980.

[8]Matson, R. E. Unpublished open file report. Montana Bureau of Mines and Geology, 1974.

[9]Stobaugh, *op. cit.*

[10]*Ibid.* [11]*Ibid.*■

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